INSTRUCTION MANUAL

FOR

Model 1076

TELEVISION ANALYST

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MODEL 1076 TELEVISION ANALYST

What The Model 1076 Television Analyst Will Do:

Some idea of the versatility of the Model 1076 Television Analyst can be gained from a quick check of the following list of major equipment features and uses.

1. As a signal generating source for point-to-point signal injection trouble shooting techniques throughout a complete TV receiver.
2. Will supply complete (video and audio) R.F. and I.F. signals to quickly trouble shoot these sections of TV receivers.
3. Will supply a complete test pattern at video (either sync positive or negative) to inject signal into video stages of TV receivers.
4. Provides a 4.5 mc sound channel, F.M. modulated with approximately 25 KC deviation. This audio carrier is modulated from either a built-in 400 cycle tone generator, or any external audio source.
5. Provides a 400 cycle audio tone signal for signal injection.
6. Separate vertical and horizontal driving pulses are available for injecting for trouble shooting sweep circuits.
7. Provides composite synchronizing signals either sync negative or sync positive, adjustable in amplitude, to troubleshoot sync circuits.
8. Provides vertical output stage plate drive signal to check vertical output transformer, and yoke.
9. Provides vertical yoke test signal to determine if vertical yoke windings are defective.
10. Provides horizontal driving signal to drive horizontal output transformer directly in a TV receiver.
11. Provides B+ boost indicator.
12. Provides hi-voltage indicator.
13. Provides sensitive leakage and continuity test for horizontal output transformer and yoke.
14. Provides sensitive test to determine if horizontal output transformer or yoke have internal shorted turns.
15. Provides a high level A.G.C. keying pulse for substitution in keyed A.G.C. systems.
16. Provides high level test signal to directly modulate TV picture tubes.
17. Built in calibrated low impedance negative bias supply.
18. As a white dot and cross-hatch generator for color TV convergence adjustments.
19. To trouble shoot and signal trace color circuits in a color TV receiver. Generates color rainbow pattern and color bar pattern.
20. By the use of the test pattern, TV receivers can be checked for bandwidth, resolution, shading and contrast capabilities.
21. Checks the R.F. sensitivity and A.G.C. settings of TV receivers.
22. To check and adjust the vertical and horizontal linearity, size and aspect ratio of TV receivers.
23. As a stable signal source for trouble shooting intermittents.
24. Will reproduce any 3″ x 4″ positive transparency as a picture source to demonstrate the performance capabilities of TV receivers.
25. As an advertising medium to display both picture and sound messages on the screens of TV receivers in department and retail stores.
26. As the transmitter for video and audio paging systems at conventions, hospitals and other gatherings.
27. To check performance of community and master antenna systems.

CONTROLS: WHAT THEY DO

Main Controls

The following main operating controls are provided on the front panel of the Model 1076 Television Analyst. (See Figure 1).

1. POWER SWITCH. This Switch is labeled Off-Stby-On, and permits the unit to be kept at readiness by using the Stand-by position to keep the tubes hot, yet prevents any radiation of signal from the unit. The pilot light will light in either the "Stby" or "On" position.
2. R.F. - I.F. SELECTOR SWITCH. By means of this Switch the Television Analyst can be tuned to channels 2 through 6, 7, 8, 12 or 13. When switched to the I.F. position the unit will transmit on I.F. Both R.F. and I.F. frequency generators are turned off in the "Off" position of the R.F. Selector Switch.
3. I.F. TUNING. This control enables the Television Analyst to tune any I.F. frequency between 20 mc and 48 mc.
4. VIDEO CONTROL. This Control is used to determine the amount of Video or contrast of the picture.
5. HORIZONTAL CONTROL. This Control is a fine frequency adjustment of the horizontal oscillator circuit in the Analyst.
6. VIDEO POLARITY (+ or –) SWITCH. This Switch determines whether the Video output signal will be of a positive or negative polarity. The positive polarity indicates positive going sync pulses; negative polarity indicates negative going sync pulses.
7. SYNC AMPLITUDE CONTROL. This Control adjusts the amplitude and phase of the sync signal available from the Sync Output jack. This control is calibrated in peak to peak volts for both sync positive and sync negative. Clockwise rotation results in positive sync. Counter-clockwise rotation results in negative sync.
8. COLOR OFF-ON SWITCH. This Switch is used to turn on the color signal for a color rainbow or color bar display.
9. AUDIO SWITCH. The Audio Switch is labeled "Off-Audio-Tone". In the "Off" position there is no audio signal being transmitted. In the "Audio" position, any external source of audio can be used to modulate the audio carrier. This source can be anything from .01 to 5 volts such as a microphone, F.M. tuner, record player, tape recorder, etc. The "Tone" position of this switch turns on an internal 400 cycle audio oscillator which is used to modulate the F.M. carrier. This tone can also be obtained at the 400 cycle output jack.
10. R.F. ATTENUATOR. The R.F. Attenuator Control determines the amount of signal output of both R.F. and I.F. frequencies. At R.F. this control should normally be set at mid-range.
11. NEGATIVE BIAS CONTROL. This calibrated Control enables the operator to select a negative voltage to ground, between 0 and 50 volts.
12. VERTICAL DRIVE AMPLITUDE. This Control adjusts the amplitude of both the vertical grid drive signal and the vertical plate drive signal.
13. PLATE DRIVE SELECTOR. This three position Switch provides a choice of a Vertical plate drive signal or a Horizontal plate drive signal to directly drive a horizontal output transformer. The third position is Off. When not using plate drive, this Switch should be in "Off" position.

14. CALIBRATE CONTROL. Calibrates the shorted turns tester and when rotated fully counter-clockwise to the "Leakage-Continuity" position calibrates the instrument for the leakage test on flybacks and yokes. If the Calibrate control is rotated clockwise the test indicator lamp will glow. To turn the lamp off, rotate the calibrate control to the Leakage Continuity position.

Output Jacks and Indicators

1. VIDEO OUTPUT. The signal at video frequencies is taken from the Video Output Jack. The polarity of the signal is controlled by the Video polarity (+ or –) switch. A separate lead is used for a ground return for this signal and for the following output signals. (Do not feed Video Signal to a point with voltage of more than 350 volts).
2. SYNC OUTPUT. High level composite sync signal is taken from this jack. Amplitude and phase are selected by the Sync Amplitude control.
3. COLOR. Color subcarrier (3.58 mc) output is taken from this jack for injection into chroma circuits.
4. 400 CYCLE. The 400 Cycle Tone signal from the audio oscillator is available from this jack at a fixed output level.
5. 4.5 MC. A 4.5 mc signal for sound system trouble shooting is available from this jack. Modulation is optional and is selected by the audio selector switch.
6. R.F. - I.F. OUTPUT. Output signal at the R.F. and I.F. frequencies are taken from this jack.
7. BIAS. The adjustable negative bias between 0 and 50 volts is available at this jack.
8. VERTICAL GRID DRIVE. Vertical Grid Driving Pulses are available from this jack to feed into the TV receiver being serviced. The amplitude of these pulses is controlled by the Vertical Drive Amplitude Control.
9. HORIZONTAL GRID DRIVE. Horizontal Grid Driving Pulses are available from this jack to feed into the TV receiver being serviced.
10. VERTICAL YOKE TEST SIGNAL. This jack provides a low impedance test signal to ground to directly drive the vertical winding of a deflection yoke.
11. A.G.C. KEYING PULSE. A high level positive going A.G.C. Pulse for use in keyed A.G.C. receiver circuits.
12. LEAKAGE-CONTINUITY. The Leakage Test for flyback transformers and deflection yokes is made between these two jacks. This test can be used to measure leakage of any component where sensitivities as high as 10 megohm is required.
13. FLYBACK YOKE TEST SIGNAL. Provides the necessary test signal to determine the presence of shorted turns in a flyback transformer or yoke.
14. TEST INDICATOR. This Indicator is used when making a shorted turns test on a flyback transformer or yoke. It is also used as the leakage indicator for the Leakage-Continuity Test.
15. PLATE DRIVE. The Plate Drive signal for either the vertical or horizontal system is available from this jack. The plate drive selector switch position determines whether it is horizontal or vertical drive.

16. B+ BOOST INDICATOR. This indicates the presence of B+ Boost in the receiver under test when plate drive from the Television Analyst is used.

17. HI VOLTAGE INDICATOR. Indicates the presence of Hi Voltage R.F. to the hi voltage rectifier plate.

18. PILOT LIGHT. Indicates that the Television Analyst is either "On" or in the "Stand-by" position.

Auxiliary Controls

In addition to the main controls on the front panel of the Television Analyst there are auxiliary controls located inside the instrument or on the rear of the chassis. The inside controls are accessible by raising the cover of the Analyst. The location of these controls are shown in Fig. 2. A duplicate of Figure 2 is located inside of the cover of the Analyst.

1. AUDIO GAIN CONTROL. (Rear of chassis). This Audio Gain Control is used to control the amount of input signal to the audio modulator when using an external audio source. This control has no effect when using the 400 cycle tone. The Off-Audio-Tone Switch must be in the audio position.

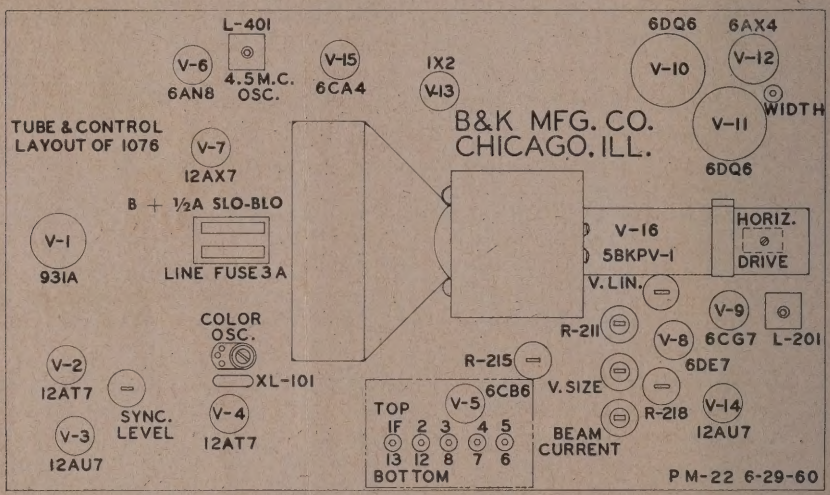


Figure 2
Layout of tubes and controls of the Analyst

2. AUDIO INPUT JACK. (Rear of chassis). External audio such as a signal from an F.M. tuner, Tape Recorder, Microphone etc. can be fed into this jack to modulate the F.M. oscillator.

3. SYNC LEVEL CONTROL. (R-121). This control sets the level of sync signal present in the composite video signal.

4. COLOR OSCILLATOR TRIMMER. (C-114). This capacitor trims the frequency of the color oscillator to the precise frequency required.

5. 4.5 MC OSCILLATOR ADJUST. (L401). This coil adjustment sets the frequency of the internal 4.5 mc F.M. oscillator.

6. WIDTH (L-2 located on the chassis between V-11 and V-12). This width coil controls the width of the horizontal scan on the 5BKPV1 scanning tube. Increasing the scan on 5BKPV-1 scanning tube reduces the size of the reproduced picture on the Television Receiver.

7. HORIZONTAL DRIVE. (C-219). This capacitor controls the horizontal drive to the horizontal output tube. Adjustment of this control establishes the operating conditions for the horizontal output tube and is effective in adjusting the horizontal linearity.

8. L-201 (Horizontal Oscillator Stabilizing coil). This coil assists in stabilizing the Horizontal oscillator frequency and is slug tuned.

9. V. SIZE. (R-207). This control adjusts the size of the scanning raster.

10. V. LINEARITY. (R-206). This control adjusts the vertical linearity of the scanning raster.

11. R-211. This is the coarse Horizontal Frequency Control and is adjusted to permit the front panel Horizontal Control to be centered in its range.

12. BEAM CURRENT. (R-221). This control adjusts the beam current of the 5BKPV1 scanning tube.

13. The centering magnets are located to the rear of the deflection yoke and control the centering of the scanning raster and therefore the centering of the reproduced picture.

14. The R. F. channel adjustments and the I.F. adjustments are slug tuned coils accessible through the holes in the shield of the R.F. assembly. The I.F. slug and channels 2, 3, 4 and 5 are the top slugs while the bottom slugs cover channels 6, 7, 8, 12 and 13.

15. R-218. This control adjusts the sensitivity of the Leakage-Continuity Test.

16. R-215. This control adjusts the voltage to the cathode of V-3A to calibrate the Sync Amplitude control on the front panel.

HOW TO SET UP THE TELEVISION ANALYST

The Television Analyst is an economical equivalent to a standard television field. Therefore, it follows that the operation and adjustments of this instrument are entirely different from the average test instrument found in the TV service field today. The adjustments which will be covered in these instructions in detail are quite simple. FAILURE to make these few adjustments may result in extremely poor performance of the equipment. IT IS, THEREFORE, MANDATORY THAT THESE ADJUSTMENTS BE MADE FOR PROPER OPERATION OF THE TELEVISION ANALYST.

The Television Analyst is an economical equivalent to a standard television station. Just as it is necessary for broadcast personnel to initially and periodically check and adjust their equipment, so too it is imperative that the same type of procedure be used with the Analyst. A decent respect for the tolerance of this equipment should be acquired by the owner so that he may understand its features, advantages and limitations.

The adjustments that are made at the factory are not necessarily the adjustments that will satisfy the conditions in your area. Not all broadcast stations throughout the country produce a test pattern that is identical in setup. It is necessary to make adjustments on the Television Analyst to set it for linearity, size and centering to match your local conditions. These adjustments are made in the following manner:

1. All areas have available at some time during the week a standard test pattern from a local TV station. We take advantage of this to setup to local conditions. Find out when this pattern is available, and allow the Analyst and a standard TV set to warm up for 5 to 10 minutes before using.

2. Tune in the station test pattern on the receiver. Find the mechanical center of receiver screen and adjust set so center of station pattern coincides with this point. Adjust receiver for good linearity, size and centering. Switch on and off the station several times to be sure the horizontal circuit of the receiver is not set at a critical point.

3. With a marking crayon or grease pencil draw circles on receiver front glass representing the circles of test patttern. The exact center of the test pattern is also marked on the face of the monitor.

4. Connect the Television Analyst R.F. output cable to the antenna terminals of the receiver along with an outside antenna.

5. Tune the TV receiver to a local channel and tune the Television Analyst to the same channel. Reduce the R.F. attenuator of the Television Analyst so that both pictures are superimposed on the receiver. It is sometimes more convenient to obtain this display with the Television Analyst on an adjacent channel.

The purpose of this adjustment is to compare the Analyst horizontal frequency to the station horizontal frequency. By adjusting the instrument Horizontal Control it is possible to have the Analyst signal slant to the left, to the right, or stand straight up, as it slides by. Adjust the Horizontal Control station picture. This puts the instrument exactly at station horizontal frequency. For reference, log the number on the panel to which the horizontal knob is pointing when instrument horizontal frequency is the same as the station frequency.

6. Tune the TV receiver to an unused channel in your area and the Television Analyst to the same channel. Adjust fine tuning on the receiver if necessary for best resolution. Adjust Television Analyst controls, Vertical Size and Linearity, Horizontal Size and Horizontal Drive, and centering so that the Television Analyst test pattern is superimposed over the circle drawn on the face of the monitor receiver. All linearity, size and centering adjustments are available by raising the hinged cover on the Television Analyst. Closing the cover will cause a very slight shift in the centering. Make your adjustments to compensate for this.

When these adjustments have been completed, you will then have matched your Television Analyst to the specific requirements of your area.

The long term stability of the Television Analyst is excellent. However, the factory recommends that all adjustments be checked periodically and that the face of the scanning tube be cleaned occasionally.

Where size, linearity and centering of a test pattern obtained from a local TV station is not the average of the most commonly viewed stations, it will be necessary for the technician to set his monitor receiver for a pattern size and centering that he knows from experience will provide viewer satisfaction when the set is in normal use.

This completes the adjustments necessary, and you may now use the Television Analyst for setup of TV receivers for linearity, size and centering, etc., with complete confidence that all receivers set up will meet YOUR local conditions.

OPERATION OF THE TELEVISION ANALYST

In order to become familiar with the operation of the Television Analyst it is suggested that you set up, on a bench, an operating TV receiver. In this way you will become familiar with the procedure and with the available signals and their uses. Assume that you have an operating TV receiver before you and a B & K Television Analyst. The Television Analyst must first be set up as per instructions on page 7.

1. Plug the Television Analyst into a 117 volt, 60 cycle, single-phase A.C. power outlet. Turn power switch to "Stand-by" position.
2. Connect one end of the R.F. test cable to the R.F. OUTPUT JACK on the front panel. Connect the other end of this cable to the antenna terminals on the receiver.
3. Insert test pattern slide into opening on top of cabinet and engage in slide track. Push slide all the way in. See Fig. 3. When viewing the slide from the left side of the instrument, the word "FRONT" should read correctly as it is being dropped into the slot.

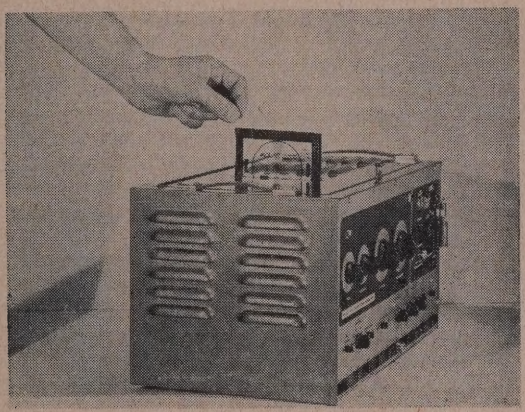


Figure 3—Inserting slide in TV Analyst

4. Turn the Television Analyst power switch to "ON".
5. Set the Channel Selector of the TV set at an unused channel, preferably Channel 6 or below. Set Analyst Channel Selector to the same channel.
6. Set the R.F. ATTENUATOR to number 5. Adjust fine tuning of monitor TV, if necessary.
7. Set brightness and contrast of monitor TV receiver at normal position. Advance VIDEO CONTROL for picture of good contrast. Adjust the VIDEO CONTROL so that the full range of grays near the center of the pattern is visible. If the VIDEO CONTROL is set too high, the picture will tend to overload and distort.
8. The HORIZONTAL CONTROL is adjusted in the following manner. Hook TV antenna and R.F. leads from Analyst to the antenna terminals of the monitor receiver. Tune monitor TV receiver to an On-the-Air TV station signal. Select the same channel on the Television Analyst, and a setting of the R.F. Attenuator, that will permit both pictures to be seen on the receiver. Adjacent channel

operation may be necessary to accomplish this. (For example Channel 3 & 4). Allow the monitor receiver to sync to the On-the-Air signal and observe the Analyst signal floating by horizontally. Adjust the HORIZONTAL control so that the Test Pattern picture stands straight up and barely floats by the TV station picture. This puts the instrument exactly at station horizontal frequency.

9. Set the AUDIO SWITCH to the "Tone" position. This will turn on the sound channel with a 400 cycle audio tone as the modulation. You will now be receiving a complete TV test pattern and an audio tone signal which is being generated by the Television Analyst and going completely through the monitor receiver.

In order to get the "feel" of the front panel controls, we will now adjust some of these controls to see the effect on the picture in the monitor.

Notice that adjusting the Video Control will change the contrast or black to white ratio of the received test pattern. The correct setting for this control is such that the picture shows the full range of greys. If this control is set too high, the picture will tend to overload and distort. Slides or photographs which have greater or less density than the test pattern slide will require a different setting of this Video Control for proper contrast.

Th R.F. Attenuator Control will allow maximum output signal when turned to the maximum clockwise position. As the R.F. Attenuator is turned down the output signal is gradually decreased until it falls to zero output. Zero output does not occur at the point marked zero on the R.F.-I.F. Attenuator but will occur at some point above it. Just before the output falls to zero an unstable condition is reached due to the extremely low level of the signal being transmitted. This unstable condition occurs at a level too low to be useful and can be ignored.

10. Turn the Audio Switch to external Audio position and inject audio signal from an external source into the External Audio Input Jack on the rear of the chassis. This signal volume can be controlled with the Audio Gain Control, also on the rear of the Television Analyst. Now, instead of a tone, the audio signal being received at the monitor TV receiver will be the audio signal being injected into the audio input jack of the Analyst. The built-in audio amplifier will accept signals from .01 to 5 volts, either low or high impedance. The volume control provides a means for adjusting levels to prevent over modulating the R.F. carrier. The 4.5 mc audio channel oscillator is accurately controlled even under varying line voltage conditions to stay within allowable frequency drift limits. The sound channel is frequency modulated with approximately 25 KC deviation at a frequency 4.5 mc above the video carrier.

After the user has become familiar with the operation of the main controls on the Television Analyst, he can proceed to learn to use the other signals available from the unit. (WHENEVER TESTING A TRANSFORMERLESS TV SET, USE AN ISOLATING 1 : 1 TRANSFORMER FOR SAFETY.)

11. Connect the R.F.-I.F. output cable to the grid of the first I.F. amplifier of the monitor TV receiver (making sure ground end goes to ground).

12. Select the I.F. position of the R.F.-I.F. Selector Switch.

13. Tune the I.F. Tuning Control to the correct I.F. frequency for the particular model receiver you are using as a monitor. The I.F. frequencies of the receivers being manufactured today and those produced within the last few years are mainly in the 45 mc region. There are, however, many sets in operation which still use the 25

mc I.F. frequencies. You will notice that when you tune to the correct I.F. frequency you will again see the test pattern and hear the tone on the monitor receiver. Tune for best picture and sound.

14. Move the R.F.-I.F. output cable from the first I.F. to the grid and plate of the second I.F. and then to the grid and plate of the third I.F. tubes and notice how the reproduced video signal on the monitor screen becomes weaker and weaker. This is an effective way of determining whether an I.F. stage is contributing gain to the overall I.F. amplifier system. Notice that with only one I.F. stage, the last I.F. stage, being used there is still enough gain to reproduce the complete test pattern on the monitor receiver. In going through the I.F. stages, it must be noted that the R.F. Attenuator Control also controls the output level of the I.F. signals from the Television Analyst. Turn the audio selector switch to "Off" and remove the R.F. cable from the monitor receiver.

15. Using the test leads provided, connect the Ground Jack on the Analyst to the chassis ground or B— of the monitor receiver. Connect the Video output jack of the Analyst to the video detector load resistor of the receiver. This load can usually be found very easily by looking for the peaking coils associated with this video detector circuit. You will now see the complete test pattern once again, if the video signal is of the right polarity. If the picture is negative, reverse the polarity of the Video Polarity (+ or —) switch. If there is more than one video amplifier stage in the monitor receiver, the signal can be injected into the grid of the second video amplifier and the test pattern can again be reproduced. It will be necessary to reverse the polarity of the video polarity switch because the polarity of the signal is reversed in going through each amplifier stage. Remove the video output cable from the monitor receiver.

16. Connect the ground jack on the Television Analyst to the chassis ground, or B— of the monitor receiver. Connect a second test lead to the sync jack of the Television Analyst and inject this signal to the grid or cathode of the picture tube of the monitor receiver. Select the element which receives video modulation. Rotate the amplitude control to +50 volts and observe black and white bars running out of sync on the monitor receiver. Rotate the sync amplitude control to the —50 volt position, notice that the phase of the modulation on the monitor receiver changes. This signal is used to determine whether or not a picture tube will accept video modulation. Restore receiver to normal operation.

17. Turn the Audio Switch to "Tone" position and connect the appropriate test leads from the 4.5 mc Audio I.F. Output jack of the Analyst to the grid of the first audio I.F. (4.5 mc) amplifier. You will now hear the audio signal in the sound system of the TV receiver. Move this signal to the grid of the video amplifier and the tone will still be heard. To verify this signal, turn the Audio Switch to the "Off" position and see if the sound in the monitor speaker disappears.

18. Connect a ground lead of the Television Analyst to ground, or B— on the monitor receiver. Remove a sync amplifier tube from the monitor receiver. If this is a series string set, short out the heater pins in the socket of the tube just removed. This permits the remainder of the receiver to operate normally. Connect a second test lead to the Sync jack of the Analyst. Inject this signal to the plate of the socket of the tube just removed. Rotate the sync amplitude control to +50 volts. If this sync signal is of the proper phase, the picture on the monitor receiver will be properly in sync. If the

picture is not in sync, rotate sync amplitude control to the opposite phase, or —50 volts. This illustrates how the sync signal is used.

19. Plug the test lead into the 400 cycle Audio Tone jack and connect the other end of the cable to the grid of the first audio amplifier tube. With the Audio Switch in the "Tone" position, the 400 cycle signal will be heard in the TV monitor loudspeaker. (NOTE:— The Audio Gain Control of the Television Analyst does not control the gain of this tone signal). Move the test signal lead to the grid of the audio output tube. The tone again will be heard in the receiver speaker.

20. Remove the audio signal lead from the monitor receiver and connect the cable from the Vertical Grid Drive jack on the Analyst to the grid of the vertical output amplifier tube of the monitor receiver. Remove the vertical oscillator of the monitor receiver. If it cannot be removed because it is a dual purpose tube, or a series heater set, disable the oscillator circuit. Notice that the pulse from the Analyst will operate the vertical amplifier and produce a vertical sweep on the TV monitor receiver. The magnitude of the vertical sweep can be controlled by the Vertical Drive Amplitude control. This sweep may not be linear, or it may not fill the complete vertical size of the picture tube because the pulse may not be matched to this particular vertical output circuit. However, it can very nicely and qualitatively determine whether the vertical amplifier circuit is operating correctly.

21. Remove the vertical pulse lead from the monitor and the Television Analyst. Connect the lead from the Horizontal Grid Drive Pulse output jack on the Analyst to the grid of the horizontal output tube (6BG6-6BQ6). Disable the TV set horizontal oscillator, or remove it from its socket. Note: Do not turn the TV set on without any horizontal driving pulse to the horizontal output tube (either from the Analyst or the horizontal oscillator of set. Without driving pulses to the horizontal output tube, the tube will burn up).

    You will notice that the horizontal output of the monitor receiver has a complete horizontal sweep and provides high voltage through the high voltage rectifier, of the receiver. This will provide a quick check to determine whether the fault is with the oscillator circuit or the output circuit in trouble shooting horizontal circuits.

22. Remove the Horizontal Grid Driving lead. Connect a test lead from the Plate Drive Jack on the Television Analyst to the plate cap connector of the flyback transformer (the horizontal output tube plate cap) of the test receiver. We are actually replacing the horizontal section, including the output tube of the receiver with the horizontal section and output tube in the Analyst. Put the Plate Drive Selector switch on the Television Analyst to the Horizontal position. Turn on the test receiver. The test receiver will now have full Horizontal scan and high voltage. The Television Analyst is providing complete drive for the horizontal output transformer of the test receiver. The B+ Boost indicator on the Television Analyst will also light indicating that B+ Boost is present in the test receiver.

23. Remove the horizontal plate drive lead from the plate cap of the flyback, and restore set to original condition. Now connect plate drive lead to the plate pin of the vertical output tube of the test receiver. Remove the vertical output tube of the test receiver. Put the Plate Drive Selector switch of the Television Analyst to the Vertical position. Apply power to the test receiver. Vertical scan will now result. The size of the scan on the test receiver can be adjusted by means of the Vertical Drive Amplitude control on the front of

the Television Analyst. The scan will not necessarily be linear but provides an excellent test on the vertical output transformer and yoke. Disconnect the Plate Drive test lead and reinsert the vertical output tube in the test receiver. Turn the Plate Drive Selector switch to the "OFF" position.

24. Disconnect the leads of the vertical winding of the deflection yoke of the test receiver. Connect one lead to ground on the Analyst and the other lead to the Vertical Yoke Test Signal jack on the Television Analyst. Turn on the test receiver. Vertical Scan will be seen on the test receiver. While not linear in deflection it proves that the vertical yoke will provide deflection. Remove test leads and reconnect vertical yoke leads to the test receiver.

25. To test a transformer for shorted turns connect the shielded cable to the Flyback-Yoke test signal jack. Adjust the Calibrate control until the test indicator lamp just goes out. Connect the flyback transformer to this cable. The connection is made from horizontal output plate cap connector to hi voltage rectifier plate cap connector. If the test indicator glows this indicates that the transformer has shorted turns. This test will respond to as little as one shorted turn. If the component to be tested is the horizontal winding of the deflection yoke, connection is made across the deflection yoke winding. It is also important to test the yoke for leakage between the vertical and horizontal winding and from the horizontal to the metal frame of the yoke.

26. To observe the action of the Negative Bias Supply, connect the Television Analyst to obtain a picture on the test receiver. Connect a ground lead from the Television Analyst to the test receiver and connect a test lead from the Negative Bias supply output jack to the A.G.C. buss of the test receiver video I.F. stages. Set the R.F. Attenuator of the Analyst to number 10, maximum R.F. output. Since the bias supply is very low impedance it will take over control from the high impedance A.G.C. system. In other words, the A.G.C. bias being fed back from the A.G.C. network is completely overcome by the bias voltage we are feeding in from our supply. We can now control the A.G.C. bias and therefore the test receiver gain. Adjusting the bias supply varies the receiver gain. With the bias supply set to —50 volts the receiver will be cut off and no picture will be seen. As the negative bias supply voltage is reduced a picture will become visible. Most receivers will begin to show a picture in the region —6 to —12 volts. As the bias voltage is reduced even further the picture will begin to overload. This will usually show up as snaking in the picture due to sync clipping. If the bias is reduced even further the picture will get blacker and then will reverse phase and then completely disappear at zero bias, indicating complete blocking of the receiver. Disconnect the bias test leads and restore the test receiver to normal operation.

27. Connect the R.F. output of the Analyst to the R.F. antenna terminals of a color TV receiver. Tune the receiver to an unused TV channel tune the Analyst to that same channel as described above. With the black and white test pattern showing, on the Color TV screen, turn the Color Switch to "On". This will switch on the 3.58 mc color rainbow generator signal. This signal will produce a color spectrum. The color sequence of the spectrum is as follows: Reddish Orange at the extreme left side of the tube, followed by a gradual transition to Red, Magenta, Blue, Cyan and Green at the right side of the tube. This color rainbow signal can be used to isolate defective stages in the color section of the color TV receiver. This chroma signal can also be fed into the I.F. section. By taking the color signal from the 3.5 mc color jack it can be fed directly into the video and chroma sections.

TROUBLE SHOOTING WITH THE TELEVISION ANALYST

The Television Analyst provides the service technician with a powerful tool to quickly and accurately trouble shoot television receivers. Outputs are provided, to enable the service technician to inject signals into any section of a TV receiver to isolate trouble to (1), a section of a receiver, and (2), to the specific stage. In many cases it is also possible to locate the exact defective component. This method of trouble shooting is called signal injection. The Television Analyst provides output signals which can be injected into any of the stages shown in Fig 4. The indication as to whether or not that portion of the receiver is capable of processing the television signal properly is seen directly on the screen of the television receiver being serviced. Signal injection is best accomplished by starting at that portion of the receiver that is farthest from the antenna.

For example:—a defective receiver is to be serviced where the complaint is "no video". Refer to Fig 4. The farthest point from the antenna in this case would be point J, the grid of the picture tube. The high level signal from the Sync output jack would be injected at this point. If the picture tube is capable of showing video, black and white blanking bars running out of sync will be seen. If the Phase of the sync signal is reversed with the Sync Amplitude control the phase of the Black and White bars will be reversed. The signal must of necessity be out of sync since the sync take off point in most receivers occurs in the video amplifier section of the receiver.

Since the picture tube circuits checked out we must now inject a video signal at point H, the grid of the 2nd video amplifier. This video signal is obtained at the Video Output jack on the Television Analyst. If the 2nd video amplifier is working properly the test pattern will be displayed on the picture tube. The signal should also be in sync since the sync take off point occurs in the second video amplifier. The proper phase of video must be selected by means of the Video Polarity switch located directly above the Video output jack. We now move our video test signal to point F, the grid of the first video amplifier, as shown in Fig. 4. Remember to reverse the phase of the video signal to account for the 180 degree phase reversal that occurs in the first video amplifier. If the test pattern failed to appear on the picture tube with the signal injected at point F we would know that our trouble must lie between point H and point F. Obviously the first video amplifier is defective. A few voltage and resistance readings will quickly locate the defective component.

If however, with the test signal injected at point F we saw a test pattern on the picture tube of the receiver, we would then have to inject a signal at points E, D and C (the grids of the I.F. amplifiers) at the I.F. frequency of the receiver. This is done by setting the R.F.-I.F. Selector switch to the I.F. position and setting the I.F. tuning to the correct frequency. Using the shielded cable provided and connected to the R.F.-I.F. output jack, inject signals to the grids of the third, second and first I.F. amplifier stages. If the test pattern signal should fail to appear on the screen of the picture tube at any of these points then the defective stage has been located. This same technique can be applied to the Tuner, the Sound system, the Sync circuits and the Deflection circuits.

As long as the signal injection point is somewhere along the series path that the signal must travel from the antenna terminals all the way through to the picture tube or loud speaker, this complete signal path can be analyzed in minutes. Included in this series path are all of the series components which are directly involved in passing the signal; for example, inter-stage I.F. transformers, video peaking coils, coupling condensers, etc.

The Television Analyst can also be used to trouble shoot intermittents. The following portions of this manual cover the methods used to trouble shoot other parts of a TV receiver, giving step by step procedures.

HOW TO USE THE TELEVISION ANALYST FOR TROUBLE SHOOTING INTERMITTENTS

TV receivers which come into the shop for intermittent troubles can be extremely time consuming and cause a great deal of irritation to the service man. This is especially true when the technician cannot even isolate the section of the receiver where the source of the trouble is located.

As a typical example, let us assume a TV set has a video coupling condensor (C4) which is opening up at random intervals for just a few seconds at a time.

The block diagram Figure 4 shows all the sections of the receiver. By using the Television Analyst we can inject signals at various points in the receiver and by observing the results isolate the difficulty down to a section or single stage. Once the stage has been isolated it is just a matter of checking the individual components in that stage to determine the actual culprit.

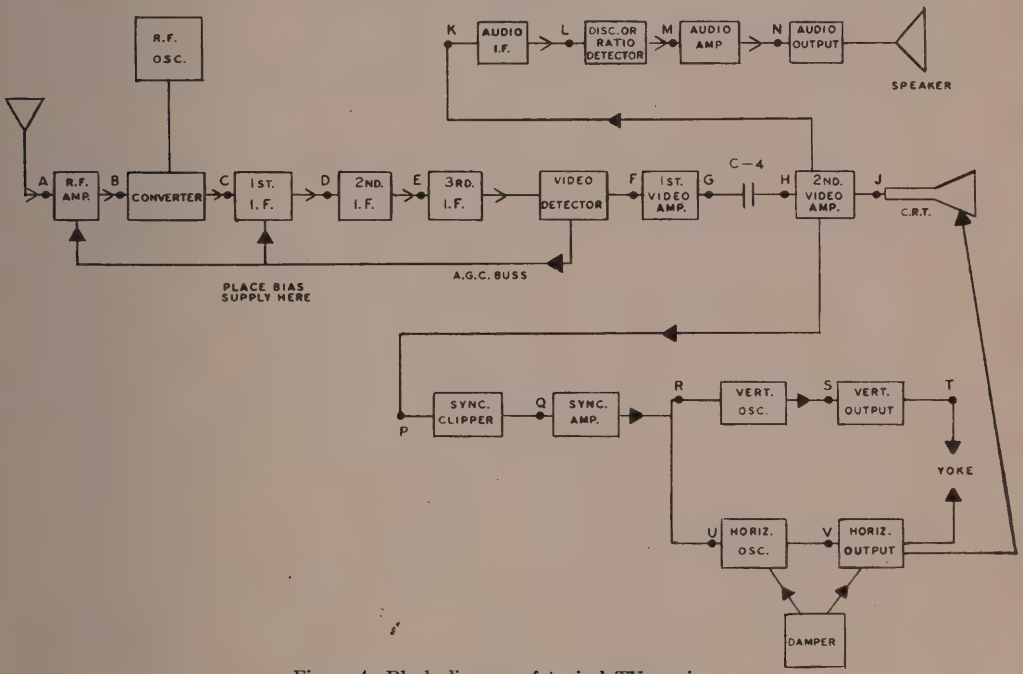


Figure 4—Block diagram of typical TV receiver

Many service men after narrowing an intermittent trouble down to one stage find it economically sound to replace the suspected components one by one until the guilty one is found. When you consider the cost of your time, it is often wise to "waste" a few 20c capacitors to save ½ hour of your time.

In the typical example:—The customer complained that the picture and sound went off for a few seconds every ten minutes. The service man in the field ascertained that when this occurred the raster was still there, eliminating the possibility of A.C. power failure, or D.C. power supply trouble. In order to get a raster, the low voltage supply must be working as well as the complete horizontal and vertical sweep and high voltage circuits.

By looking at the block diagram it can be seen that the video and audio signals are together in all the R.F., I.F. and Video stages. It is after the last video amplifier that the video and audio separate. Since both video and audio

are lost when the intermittent trouble appears, it is obvious that the trouble must be in the R.F. tuner, I.F. amplifier, Video detector, Video amplifier or A.G.C. circuits.

The Television Analyst will now be used to locate the source of the trouble. The signals available from the instrument will be injected into the receiver at various points, so that by the process of elimination the trouble can be analyzed down to one stage.

First it is necessary to disable the A.G.C. circuits by connecting a bias supply to the A.G.C. buss which feeds A.G.C. voltage to the tuner and I.F. amplifier stages. (Incidentally, if the trouble were in the A.G.C. circuit, using this external bias supply would probably eliminate any symptoms of trouble. This would indicate that the source of trouble was in the A.G.C. Circuits).

Now by feeding R.F. signal into the antenna terminals of the set (A) the test pattern and sound will intermittently disappear, just as it did on the local TV stations.

By moving our signal injection point stage by stage from the antenna terminals to the picture tube, we can localize the trouble. Still using R.F. ouput, inject the signal on the grid of the R.F. converter tube (B). If the intermittent still appears, it means that the trouble is NOT in the R.F. amplifier stage, or the R.F. oscillator.

Now we switch the instrument output to the I.F. signal, and inject this signal at the same point at the grid of the converter (B). (Note:—If the intermittent appeared when R.F. signal was fed to the grid of the converter, and it did *not* appear when I.F. signal was fed into the grid of the converter, then the trouble would have been pin-pointed directly to the R.F. oscillator).

With I.F. signal fed into the converter grid (B) we find that the intermittent still appears. That means the R.F. oscillator is not causing the trouble.

Now we move our signal cable to the grid of the first I.F. amplifier (C). Finding the trouble still intermittently appearing, we move our signal to the second (D) and the third (E) I.F. stage. (Obviously, if the trouble appeared when injecting on the grid of the second I.F. stage (D), but no longer showed up when injecting signal to the third I.F. stage (E), the trouble would have been pin-pointed to the second I.F. stage).

Since the intermittent still appeared, the Television Analyst signal output is now switched to Video and the signal is injected into the video detector load. (See Figure 5). This is usually around a 4,000 ohm resistor and can easily be located because it will have a video peaking coil associated with it. (Note:—For video signal make sure you are using the correct output cable as it is *not* taken from the same output jack as the R.F.-I.F. signals. Also, if the picture appears negative, reverse the polarity of the video signal with the Video Polarity (+ or —) Switch).

Since the intermittent trouble still appears, the video detector has been eliminated from suspicion and the video signal is injected on the grid of the first video amplifier (F). The intermittent trouble still shows up at this point.

The video signal is now injected into the grid of the second video amplifier tube (H) after reversing the polarity with Video Polarity (+ or —) Switch to compensate for the 180° phase reversal in the first amplifier tube. Now, for the first time, the intermittent disappearance of sound and video is no longer evident. The trouble has been isolated to an area between the grid of the first video amplifier (F) and the grid of the second video amplifier (H).

Now to use the Television Analyst once more to check the coupling capacitor (C-4) from the plate of the first video amplifier to the grid of the second video amplifier. Inject the video signal on the plate side (G) of the coupling

capacitor (See Figure 5). The intermittent condition again appears, placing the blame for intermittent loss of signal to the coupling capacitor C-4 which is opening up intermittently.

(If it were the first video amplifier tube itself, screen bypass capacitor C-1, plate load resistor R-2, peaking coil L-4, or any other component in the first video amplifier circuit, the trouble would not have appeared with the signal injected at point (H) in the circuit. However, if the signal was injected at point (K) on the plate of the first video amplifier and the same intermittent indication appeared, then both the peaking coil L-3 and the coupling capacitor C-4 would be suspected).

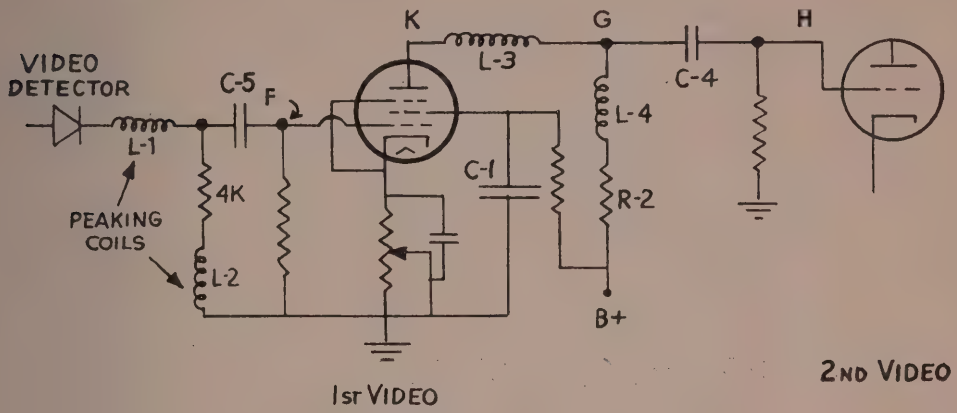


Figure 5—Video section of typical TV receiver

It should be clear at this point that the signal injection procedure can actually begin at either end of the circuit. That is, we could have started at video and worked toward the R.F. Tuner, or start at the Tuner and work toward the Video. Each individual technician will develop his own technique for use of the instrument. Where the trouble is an intermittent one, then it is sometimes preferable to start at the tuner because we are looking for a "drop out or loss" of signal for short intervals.

Where the trouble is in the circuit constantly, it may be preferable to start at the video end and work toward the R.F. tuner. Also it is evident that as the technician becomes more familiar with the instrument he will skip stages for quick analysis and take complete sections at one time (I.F., R.F., Video). After determining which section is at fault, he could then signal inject to find the one stage or component which was at fault.

Let us take another example of a receiver which comes into the shop having intermittent sync. The sync circuit of this receiver is shown in Fig. 6. Let us trouble shoot by signal injection from the rear of the signal path. We inject sync signal from our Television Analyst to the plate of the 6BF6 sync amplifier. We would now observe the raster of the television set and would see that it was in sync.

If the picture now remains in sync, this would tell us that from the plate of the sync amplifier tube into the oscillators there was no trouble. We would now shift our point of sync injection to the grid of the 6BF6 sync amplifier. At this point we would have to reverse the phase of the sync signal to allow for the phase inversion of the sync amplifier tube and also reduce the level of the sync signal to take into account the gain of this stage. Again we would observe the picture on the face of the tube and watch for the intermittent trouble to occur. If it did not occur, we would know that there was no difficulty from the grid of this amplifier tube all the way through to the oscillators.

We will now shift our sync signal to the plate of the 6AU6 sync separator and again observe the picture on the face of the CRT. We now find that the intermittent sync condition occurs. This tells us that the trouble lies between the plate circuit of the 6AU6 sync separator and the grid circuit of the 6BF6 sync amplifier. A few voltage and resistance measurements would now certainly point out the trouble. It might even be worth while to replace all of the components that lie between plate of the 6AU6 and the grid of the 6BF6, since this would save a great deal of time and would eliminate the necessity of determining which component is intermittent.

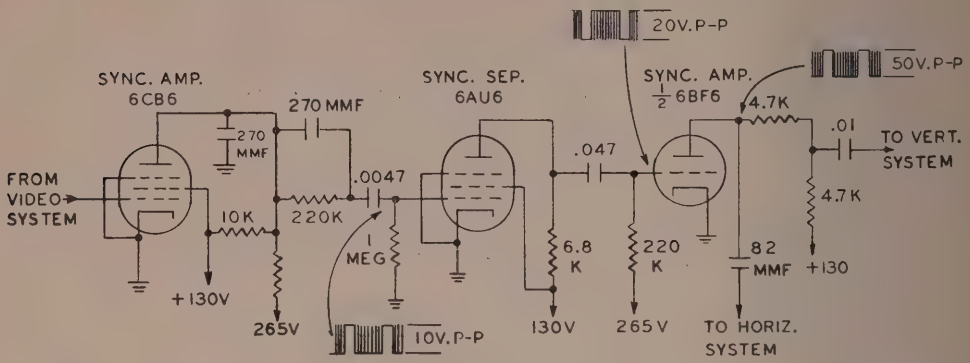


Figure 6—A sync separator system

As you can see, this sync injection method for locating intermittents will in every case isolate the trouble to a particular stage. From that point on the repair is very simple.

HOW TO USE THE TELEVISION ANALYST FOR TROUBLE SHOOTING LOSS OF AUDIO

This trouble shooting procedure for Audio I.F. Stages applies to intercarrier type of sets.

Let us assume there is no audio in a TV receiver. Within a couple of minutes we will find the defective stage by using the Television Analyst. Refer to Fig. 7. Assume a shorted screen bypass capacitor (5000 mmf) on the 4.5 mc Audio I.F. amplifier.

To check the speaker and audio output stage, inject the 400 cycle audio tone on the grid of the audio output tube (point A). A good tone will be heard. Then move the signal injection point to the grid of the audio amplifier (point B). Now use the 4.5 mc audio I.F. output with 400 cycle tone modulation and inject the signal at the plate of the sound I.F. amplifier (point C). You will still hear the tone signal indicating all the stages from this point to the loudspeaker are O.K. Now the 4.5 mc signal is injected on the grid of the 4.5 I.F. amplifier (point D), and the tone signal is no longer heard in the loudspeaker. This immediately tells you that the trouble is in this stage. A simple voltmeter test will discover the bad component, as no B+ or very low B+ will appear on the screen of this tube. It is always a good practice to check the screen dropping resistor under these conditions, to see if the excessive current has caused it to increase in value.

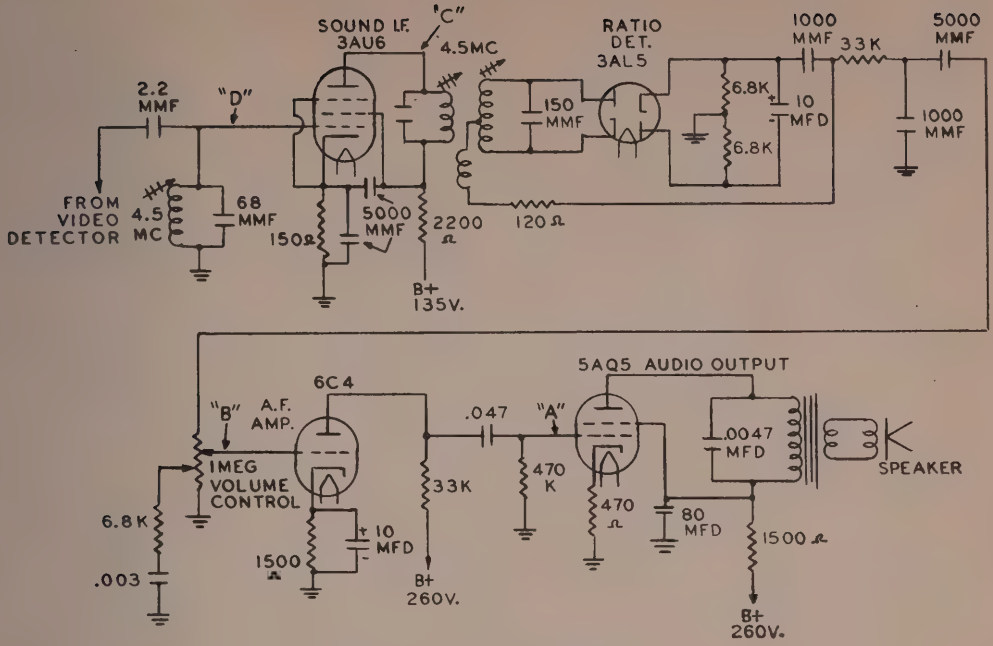


Figure 7—A typical TV audio system

HOW TO TROUBLE SHOOT SYNC AMPLIFIERS AND SYNC SEPARATOR STAGES

With the Television Analyst it is possible to quickly and thoroughly check the sync separator stages of any television receiver. To illustrate the procedure to follow, three representative sync separator sections will be discussed.

A fairly simple sync separator system is shown in Fig 8. This is seen to consist of the two triode sections of a 7AU7. We will assume that the pic-

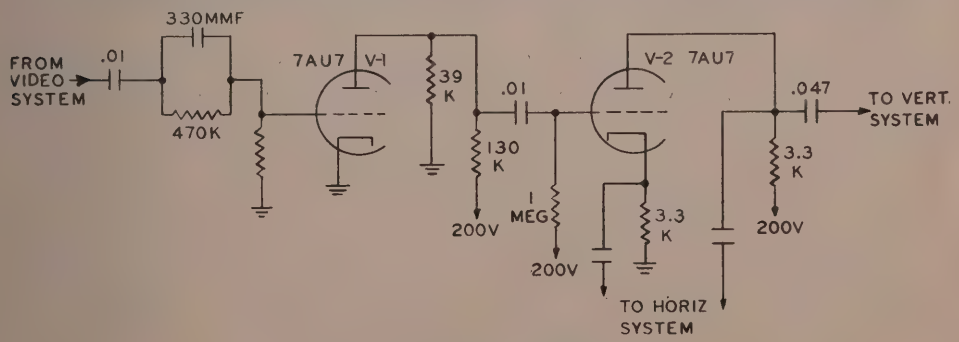


Figure 8—A typical sync separator system

ture is completely out of sync vertically and horizontally and we wish to check out these stages to determine if the trouble lies here.

As a first step, connect the Television Analyst to the receiver so that an image appears on the screen. The point of signal injection may be at the

antenna terminals. It would be desirable not to inject the test pattern signal into the video amplifier stages because we might do this beyond the point where the sync signal take-off occurs. Rather than spend time looking for this point, inject the signal as indicated above.

The next step is to apply a composite sync signal from the Television Analyst to the grid (and chassis or B—) of V2, Fig. 8. It is important that the proper polarity sync signal be applied and ordinarily the technician would have to figure this out by checking through the schematic. With the Television Analyst such checking is not necessary. Simply apply the sync pulses from the Television Analyst to the control grid of V2. If the image on the screen locks into sync, we know the sync signal is passing through V2 and locking in the vertical and horizontal oscillators, and we have chosen the proper phase of sync signal.

If the picture on the screen remains out of sync then reverse the polarity of the sync signal by turning the Sync Amplitude Control to the other phase. This is the reason we do not have to know the proper sync signal polarity before hand. The Analyst permits us to try both phases by simply rotating the Sync Amplitude control. The picture will lock in now, if both deflection systems are operating normally.

If the picture still remains out of sync, the sync pulses are not reaching the vertical and horizontal sweep oscillators. In that case inject the sync pulses at the plate of V2 and repeat the procedure. The receiver should now sync indicating that the trouble must lie between the grid circuit and the plate circuit of V2.

If application of the test pulses at the grid of V2 does lock the picture in, shift the signal injection lead to the control grid of V1. Inability to sync the picture indicates a defect in V1 or its associated circuit. Voltage and resistance checks should then uncover the faulty component.

The level of the test sync pulses may be set at any point between 0 and 50 volts. In most instances, a mid-setting of the sync level control will serve satisfactorily. However, if you find that the full 50 volts peak-to-peak must be used in order to secure adequate synchronization, chances are there is something defective in the circuit. It may be that the pulses are not being properly amplified or that some component has radically changed its value, reducing the stage gain far below its normal figure. It is also well to keep in mind that the level of the injected sync pulses should be lowered whenever the signal lead is moved from plate to grid of a stage, or in going from the grid of one stage to the grid of a prior stage. In short, whenever you add more stages through which the pulse signal must pass, lower the output of the Sync Amplitude control.

Since the Sync Amplitude control is calibrated in volts, any level of signal required may be injected into a receiver sync system. A schematic may indicate that 35 volts peak-to-peak may be required to drive a particular stage. By setting the sync level control to 35 and injecting sync at this point you may determine if that stage will work properly with this level of signal.

A more elaborate sync separating system is shown in Fig. 9. The method of approach is still the same, however. That is, when a symptom of poor synchronization appears, you inject the composite sync signal from the Television Analyst at the plate and grid of each stage in the sync separation system, working from the stage closest to the deflection systems back to the stage that receives the initial video signal from the video system. The only thing to remember is that sync polarity must be reversed when switching from plate to grid. Failure to observe this precaution may erroneously lead you to believe that a stage is defective.

As a precautionary rule, whenever you reach a point in the sync separator system where the injected pulses do not lock in the picture, try both polarity pulses. If you find that one polarity of sync pulse does lock in the picture, the stage is operating satisfactorily.

Within the past few years pentagrid tubes have been employed for the sync separating function, at the same time also helping to reduce the amplitude

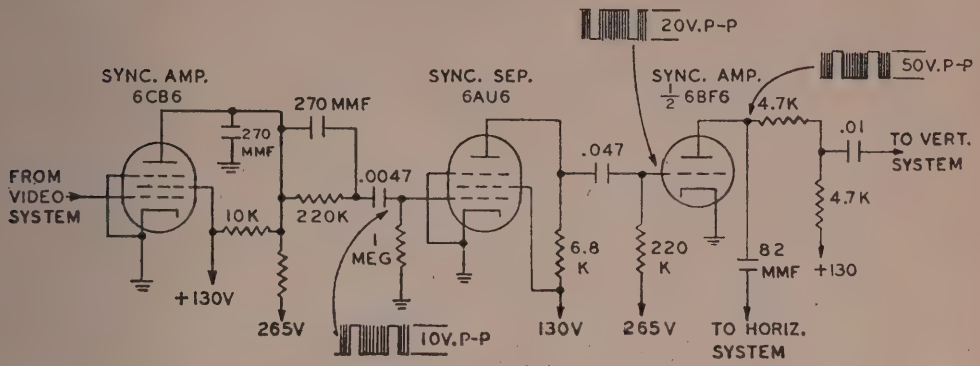


Figure 9—A more elaborate sync separator system

of any noise pulses that may be riding along with the signal. A typical circuit of this type is shown in Fig. 10. There is a 6BY6 pentagrid tube followed by a triode sync amplifier. A fairly small video signal with the sync pulses negative is fed to grid No. 1. The sync stabilizer control connected to the grid is adjusted so that tube current just flows with normal input signals.

An amplified version of the same video signal, with the sync pulses positive now, is obtained from the plate of the video amplifier and applied to grid No. 3 of the 6BY6. These sync pulses are strong enough to cause grid currents to flow in this circuit, charging capacitor C1 to a value approximately equal to the peak-to-peak amplitude of the applied pulses. In the interval between pulses, the negative voltage on grid No. 3 is high enough to pre-

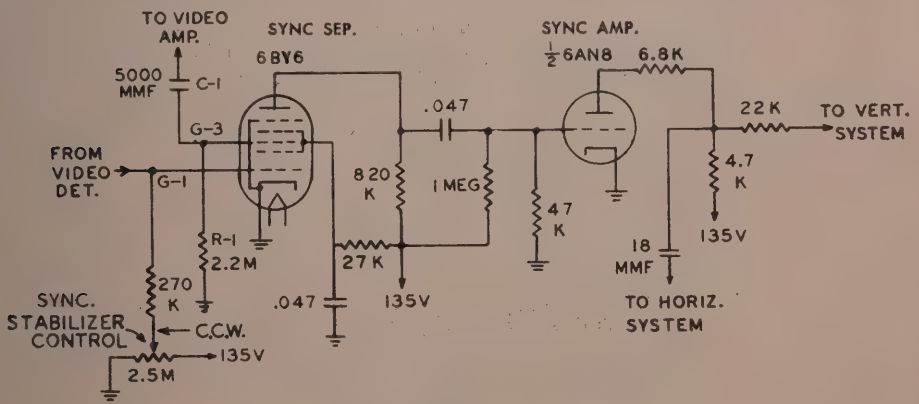


Figure 10
Sync Separator System

vent current from flowing through the tube. Thus, when the circuit is operating normally and a video signal is received, current will flow through the 6BY6 only during the sync pulse interval and only sync pulses will appear across the output load resistor.

Consider now what happens when noise pulses appear at the same time. These noise pulses will be transferred first to grid No. 1 and if they are strong enough, they will cut this grid off. The same noise pulses, reversed 180°, will appear at grid No. 3. However, since grid No. 1 has cut the current off, nothing will appear in the plate circuit. In this way the 6BY6 suppresses any pulses which arrive stronger than the sync pulses. The pulses received from the 6BY6 by the following triode (½-6AN8) are then amplified and forwarded to the vertical and horizontal deflection systems.

To check out such a system when non-synchronization occurs, we would proceed as follows. With the set in operation, apply a composite sync pulse from the Analyst to the plate of the 6AN8 triode. If the picture locks in, reverse the polarity of the sync pulses and apply them to the grid of the same tube. If the circuit is functioning normally, the picture will again become synchronized. Now reverse the polarity of the applied sync pulses again and then touch the probe to grid No. 3 of the 6BY6. If the picture synchronizes, the sync separator system is functioning normally. If the circuit does not permit sync pulses to pass through, trouble in the 6BY6 stage is indicated. While the pulses are being applied to grid No. 3 of the 6BY6, rotate the sync stabilizer control in the receiver completely counter-clockwise. This places 0 volts on grid No. 1 and permits plate current to flow through the tube.

If injected test pulses at grid No. 3 synchronize the image but the receiver, without the injected sync pulses, still displays the same lack of synchronization, then the path between the 6BY6 and the preceding video system should be checked. Move your probe back component by component, until you reach the video system. An open capacitor, an open resistor or a shorted shunt capacitor will be readily uncovered by this point-to-point tracing method.

The sync pulses delivered by the Analyst are powerful enough to be applied directly to the integrator network leading into the vertical oscillator or to the capacitor leading into the horizontal phase detector. Thus you can trace the signal path from these two deflection systems all the way back to the video amplifier system of the receiver.

HOW TO TROUBLE SHOOT A.G.C. SYSTEMS

Locating defects in the A.G.C. (Automatic Gain Control) system in a television receiver represents one of the more difficult troubles that the technician is called upon to service. The first step that must be performed is the positive

Figure 11—The appearance of an image produced when one of the video I.F. stages has been overloaded

proof that the trouble lies in the A.G.C. system. Once this has been established the location of the defect will be relatively simple.

Let us take as an example the case of a television receiver where the customer complains of a picture that seems to be negative and out of sync. The Television Analyst is connected to the antenna terminals of the receiver

and the test pattern signal tuned in. The displayed picture appears in Fig. 11. We must now take the video output signal from the Analyst and inject this signal to the grid of the 1st video amplifier. The result is viewed on the television receiver's picture tube. We observe that the displayed picture is satisfactory and we see the normal test pattern signal appears properly in sync. We must therefore conclude that the trouble does not lie in the video portion of the receiver. We now select an I.F. signal from the Television Analyst of the proper frequency and inject this signal to the grid of the 1st Video I.F. amplifier. This is point A in Fig. 12. Examination of the picture displayed on the receiver picture tube shows a negative picture that is out of sync. This is the same result that we saw in Fig. 11. Therefore, the trouble apparently lies in the I.F. portion of the receiver. We will now try to isolate the trouble to a specific stage.

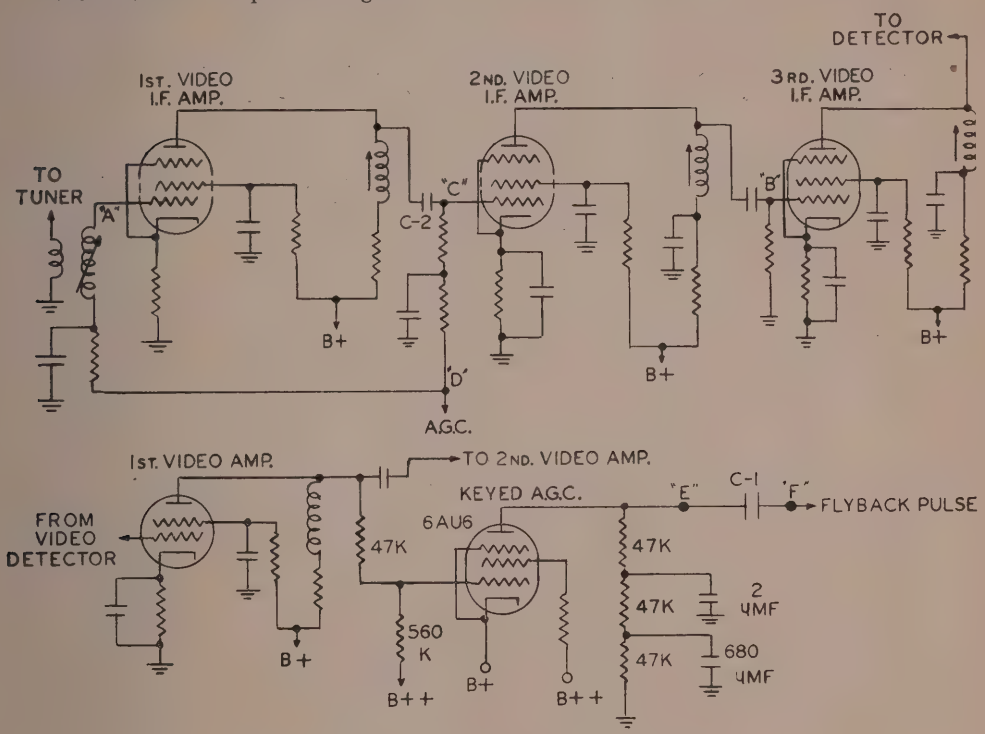


Figure 12—Video I.F. system and Keyed A.G.C. circuit

Since the trouble has been isolated to the video I.F. stages we will now examine each stage in turn to locate the difficulty.

Inject I.F. signal at point B which is the grid of the third video I.F. amplifier. We now observe on the screen that the picture appears to be normal. That is it is of the proper phase and is in sync. Notice that this stage is not controlled by A.G.C. The signal might be a little weak since very little gain is obtained using only one stage of video I.F. amplification. We now move our I.F. injection signal to point C, (the grid of the 2nd I.F. Amplifier) and again observe the result on the receiver picture tube. We now see that the receiver display is negative and out of sync. The trouble apparently is in the second video I.F. stage. Examination of the schematic of Fig. 12 will show that both the second I.F. stage and the first I.F. stage are subject to the controlling action of A.G.C. voltage.

Since the picture displayed in Fig. 11 could be caused by overload of the I.F. stage it might be wise at this point to determine the signal handling capabilities of these stages. By reducing the setting of the R.F.-I.F. Attenuator on the Television Analyst we are capable of lowering the level of the I.F. output to very low levels. As the amount of I.F. is reduced we reach a point where the picture on the customer's receiver no longer appears negative and is in sync. The picture will very likely be snowy as the signal is very weak at this point. We have now proved that the receiver is capable of handling a very weak signal but is certainly not able to handle a strong signal. This definitely points to an A.G.C. defect. The next step is to see if the I.F. strip will accommodate a strong signal if an external bias voltage is used to control the gain. With the I.F. signal injected at point C we connect a test lead from the bias supply of the Television Analyst to point D which is the A.G.C. feed point. A ground lead from the Television Analyst must also be connected. With the Negative Bias control set to —50 we see that the picture has completely disappeared. This is due to the fact that with this large bias we have cut-off the I.F. amplifier. As the bias voltage is reduced we will observe that a picture will begin to appear at around 6 to 12 volts. At about 3 or 4 volts we observe a normal picture and as the bias is reduced even further the sync begins to get unstable and then finally turns negative. These tests conclusively prove that this I.F. stage in the receiver is capable of handling without overload a wide range of signals running from the very weak to the very strong only if external bias control is exerted on the I.F. stage. This proves conclusively the trouble must be related to the A.G.C. circuits. Remove the negative bias lead.

The receiver under test employs a keyed A.G.C. system, which depends for its operation on a high level pulse which is derived from the horizontal deflection system. The absence of this pulse will render the A.G.C. inoperative, and cause the receiver to overload. We now disconnect capacitor C-1 at point E. Connect a test lead from the A.G.C. Keying Pulse jack on the Television Analyst and insert this high level pulse at the plate of the A.G.C. tube (E). We now see that the picture on the receiver screen has been restored to normal operation when I.F. signal is injected at point C, the grid of the 2nd I.F. amplifier tube. The trouble could be a defective C-1 or an open winding on the coil supplying the A.G.C. pulse. Reconnect C-1 and try inserting the A.G.C. pulse at point F. If proper operation results then C-1 is O.K. A resistance reading in this case will immediately show that the pulse coil is the defective component.

Another example of an A.G.C. trouble is as follows. A receiver having the same symptoms as the previous example is to be repaired. Signal injection has isolated the trouble to the 2nd video I.F. stage. We find that by reducing the I.F. Attenuator control until the signal is at a very low level that a normal picture results. We now connect the negative bias supply to point D in Fig. 12 which is the A.G.C. bias buss. We find that adjustment of the Bias Control will not result in a normal picture at any setting of the control, with signal injection at point C at the I.F. frequency. These two tests indicate that the I.F. strip will amplify, as indicated by its ability to show a picture when the signal is very weak. However when the signal is very strong, a control voltage placed upon the A.G.C. buss has no effect on the stage as indicated by the use of the negative bias supply. This would indicate that if the A.G.C. system were operating normally it would have no effect on the stage gain and therefore the trouble must be peculiar to the 2nd video I.F. amplifier and must not relate to the control voltage that the A.G.C. system exercises. This points to the Grid circuit. A few voltage and resistance checks indicate a slight positive voltage on the grid of the 2nd I.F. amplifier. A positive voltage was found on the grid of the stage and a resistance check showed a leaky C-2.

In summary the receiver I.F. system must pass two tests to establish that the trouble is specifically in the A.G.C. First it must be capable of amplifying a very weak signal without distortion. Secondly, with a strong signal input

and an external bias supply, control can be maintained. If both of the conditions are met then the trouble is definitely A.G.C. If only one test is passed then the trouble must be peculiar to the I.F. stage under test.

TROUBLE SHOOTING VERTICAL SWEEP CIRCUITS

The following steps should be taken when checking the vertical deflection systems. We will assume that the indications on the television receiver screen to be tested reveal that there is no vertical driving voltage being delivered to the vertical winding of the deflection yoke resulting in a horizontal line on the picture tube.

In order to isolate the defects in a receiver between the vertical oscillator stage and the vertical output stage, proceed as follows:

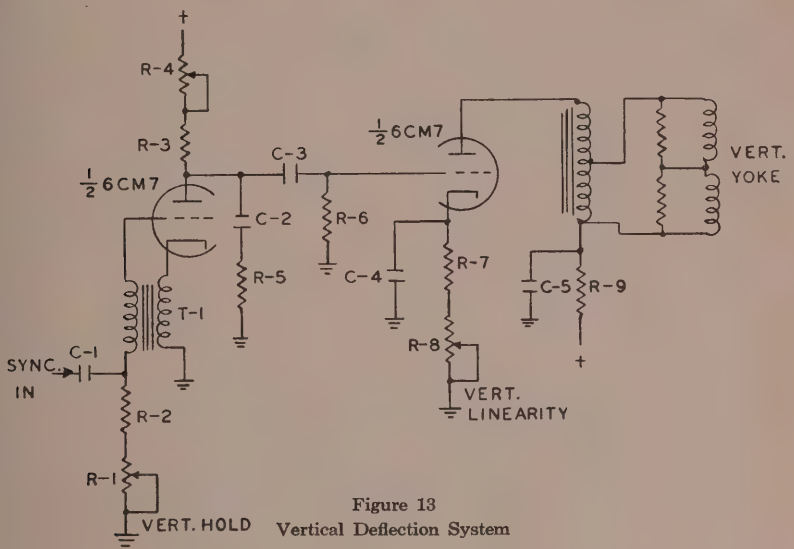


Figure 13
Vertical Deflection System

1. Using the Vertical Grid Drive pulse available on the front of the Television Analyst, apply this signal to the vertical output stage grid (see Fig. 13). If, when this signal is applied, the image develops vertical deflection, then we know that the proper driving signal is not being supplied to the output stage by the vertical oscillator. The defect is either in the oscillator itself or in the capacitor (C-3) coupling the oscillator to the output stage. However, if vertical deflection of the image does not occur when the signal is injected at the grid of the output stage, the defect is located somewhere between this grid and the deflection yoke.

   The grid driving pulse signal may not necessarily result in linear deflection on the screen of the television receiver. However, we are primarily interested in the presence or lack of deflection. A closer approach to good linearity can be obtained by adjusting the linearity control in the receiver (R-8) in Fig. 13 and by adjusting the Vertical Drive Amplitude control located on the front of the Television Analyst. In all cases this control should be at maximum when first starting to troubleshoot vertical deflection systems.

2. Assuming that no vertical deflection results when the signal is injected at the grid of the output stage, inject the Vertical Plate Drive pulse from the Television Analyst at the plate of the vertical output

tube. The vertical output tube itself is removed from the set. In sets where the heaters are series-wired, the filament terminals on the socket can be shorted out, so that all the other tubes in the series string will continue to operate.

We are now driving the output transformer from the vertical output stage contained within the TV Analyst. However, the B+ applied to this remote output stage in the instrument is derived from the receiver circuit itself. If vertical deflection is restored with this plate signal, the defect is in the vertical output stage, generally in the cathode circuit, assuming the tube to be good. If the vertical deflection is still missing then it indicates that either the vertical output transformer or the vertical windings of the deflection yoke are at fault.

We are assuming, in the preceding paragraph, that B+ is reaching the plate of the vertical output tube. This B+ is required by the TV Analyst to power its output tube. If no B+ should be present, no signal will be obtained from the PLATE DRIVE terminal. Hence, if application of the test lead from the instrument at the plate of the output stage does not produce vertical deflection, it would be desirable to check the voltage in this circuit to make certain it is present. Absence of the necessary voltage indicates an open circuit in the vertical output transformer winding, or an open resistor or shorted capacitor in the B+ network bringing this voltage to the vertical system.

To check the vertical windings of the deflection yoke, disconnect its wires from the circuit and connect them to the two test leads from the Vertical Yoke Test Signal jack and GROUND of the TV

Figure 14—Sweep developed using vertical yoke test signal

Analyst. If the yoke is good, vertical deflection of the picture tube image will result. The image will possess poor linearity and overlap or go back itself (Fig. 14) because the driving signal is a sine wave and not a sawtooth. However, we are not concerned here with checking linearity and, therefore, any indication of deflection would reveal the yoke to be good. The trouble now is definitely indicated to be in the vertical output transformer.

TROUBLE SHOOTING HORIZONTAL DEFLECTION CIRCUITS

We come now to the horizontal circuit of a television receiver and it is here that the instrument offers the service technician several quick test features that will greatly simplify the task of servicing this section of the set.

One such outstanding feature is the ability to check the output circuit completely, both from the grid of the horizontal output tube and from the

plate of this stage. In essence, then, we can completely bypass the horizontal output tube. A second innovation is two indicator lights which further serve to pin-point troubles in the output transformer, or the high voltage network. The lights operate on a "go - no-go" basis, clearly revealing to the serviceman the presence or absence of certain hard-to-find troubles.

And last, but not least, sensitive leakage and shorted-turns tests can be made quickly and conclusively on yokes and horizontal output transformers, again providing the user with positive information.

Let us assume the receiver under test has no picture or raster and there is an absence of high voltage.

1. In order to determine whether the defeat lies in the horizontal oscillator stage or the horizontal output amplifier and the stages following it, proceed as follows:

   Using the Horizontal Grid Drive pulse available from the front panel of the TV Analyst apply this signal to the grid of the horizontal output tube. Connect the high voltage indicator lamp to the insulated wire going to the plate cap of the high voltage rectifier tube and remove the plate cap from this tube. See Fig. 15. Apply power to the receiver under test and observe the high voltage indicator lamp.

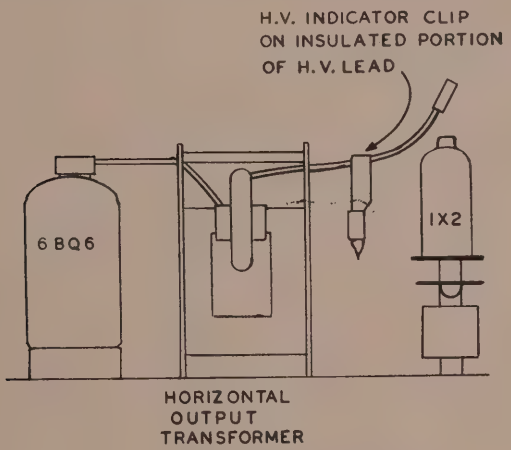


Figure 15—Connecting High Voltage Indicator

If the lamp glows this indicates the presence of high level R.F. pulses on this lead. Turn off the power and reconnect the high voltage plate lead to the rectifier tube and again apply power. If the high voltage rectifier circuit is O.K., the lamp should still remain lit and hi voltage should be present and deflection will be observed on the face of the CRT. Since the application of a driving pulse to the grid of the horizontal output resulted in restoring operation to the receiver the trouble definitely lies in the horizontal oscillator circuit. A few voltage and resistance checks will certainly bring the trouble to light.

Let us take another case where no hi voltage is again the trouble. Application of grid driving pulses do not restore hi voltage or deflection. This indicates that the trouble is not in the horizontal oscillator but that the difficulty lies in the output circuit of the receiver. Turn the Plate Drive Selector switch of the Television Analyst to the Horizontal position. Connect the ground lead of the instrument to chassis ground or B— and connect a test lead from the Plate

Drive jack to the plate lead connection on the horizontal output transformer. Be sure the hi voltage indicator lamp is connected to the plate cap lead going to the hi voltage rectifier and that this lead is removed from the plate cap of the tube. Apply power to the receiver and observe the B+ boost indicator lamp on the front of the TV Analyst and the hi voltage indicator.

If both the B+ boost indicator and the hi voltage indicator lamps come on, they indicate the presence of boost voltage in the flyback system and hi level R.F. pulses in the hi voltage lead. Both of these indications tell us that the flyback system is now operating properly. The trouble must be in either the high voltage rectifier circuit or the output tube circuit. To eliminate the hi voltage circuit, reconnect the plate cap of the hi voltage rectifier tube, apply power to the receiver, and again observe the boost indicator and the hi voltage indicator. If both are lit this indicates that the high voltage rectifier circuit is O.K. We must still check whether the high voltage dropping resistor R-4 is open, preventing the high voltage from getting to the picture tube. If R-4 is O.K., then this proves conclusively that the trouble must be in the horizontal output tube circuit. It could be the screen resistor R-1, or by pass condenser C-1, or the cathode bias resistor R-3. (See Fig. 16)

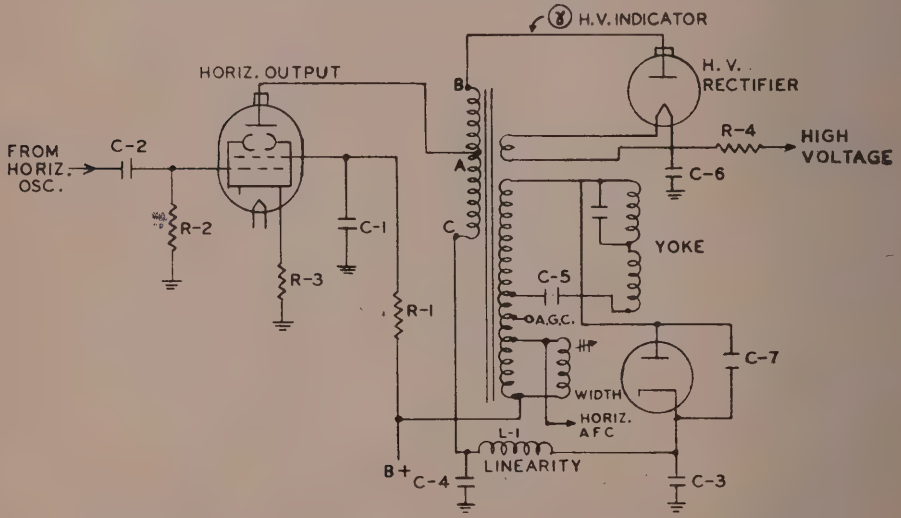


Figure 16—A horizontal output section using an isolation type of output transformer

Screen voltage is applied to the horizontal output tube through the screen dropping resistor R-1. There is also a bypass capacitor C-1 between the screen grid and ground. If resistor R-1 increases in value, the screen voltage will decrease, there will be less drive to the horizontal output transformer, and the picture width will decrease. If R-1 opens up, there will be no drive and no high voltage. Generally, if R-1 is open it will be found that capacitor C-1 has shorted and the excessive current drain has caused R-1 to burn out. In this case, both C-1 and R-1 should be replaced. As a matter of prudence, whenever R-1 has been found to increase in value substantially, it is good practice to change capacitor C-1 because it frequently is the cause of such resistance change.

In the grid circuit of the horizontal output stage, grid leak resistor R-2 and coupling capacitor C-2 bring the signal to the horizontal

output stage from the horizontal oscillator. This coupling capacitor is frequently the cause of much difficulty in the horizontal output circuit. If C-2 becomes leaky or shorted, a positive voltage will be applied to the control grid of the horizontal output stage from the plate circuit of the oscillator. If the leakage resistance of C-2 is low enough, this could load down the horizontal oscillator circuit sufficiently to prevent any horizontal output or high voltage from being developed.

It is interesting to note, that if C-2 is leaky, with a fairly low resistance, applying the grid driving pulse to the horizontal output stage from the Analyst may not cause the high voltage to reappear since the shorted coupling capacitor may load down the Analyst circuit as well. To see if this is so, uncouple one side of C-2 and reapply the grid drive. If the high voltage now appears, capacitor C-2 should be changed.

2. If you find that injecting the signal from the TV Analyst at the plate of the horizontal output tube *does not* restore high voltage, then the trouble lies somewhere in the circuit *beyond* the horizontal output stage. NOTE: This is a *conclusive* test and it due *entirely* to the fact that the TV Analyst can take the place of the horizontal output amplifier.

The procedure to check out the output circuit with the instrument is as follows:

The cap lead is lifted from the top of the horizontal output tube; also the cap lead connecting to the high voltage rectifier is removed from its tube. As an added precaution, the high voltage rectifier tube is removed from its socket. The TV Analyst is then set to deliver a horizontal plate driving pulse. The lead from the Plate Drive terminal is connected to the cap lead that ordinarily goes to the horizontal output amplifier. Next, the B & K high voltage indicator light is attached directly to the *insulated* wire leading to the cap that connects to the high voltage rectifier. (See Fig. 15). The instrument and the television receiver are both turned on.

If the boost indicator light on the panel of the TV Analyst lights up, as well as the high voltage indicator, high voltage is being developed, boost B+ is present, and R.F. is being produced in the circuit. This is the condition that would generally be obtained when the set is working normally. In the present instance, the set is presumed to be defective; therefore, if such an indication is obtained, but there is no high voltage on the picture tube as indicated by lack of raster, it is possible that capacitor C-6 in Fig. 16 may be shorted, or the high voltage cable is not connected to the CRT. (We are assuming that all the tubes in the circuit including the picture tube have previously been checked before any testing with the instrument is begun.)

Another possible cause of no raster when the hi voltage indicator lights up is an open in the current limiting resistor R-4, preventing any high voltage from appearing on the picture tube. Each of these components can be checked individually to determine which is defective.

If the boost indicator lights up when the horizontal plate drive is applied to the transformer but the hi voltage indicator *does not* and there is no high voltage, then we have a definite indication that the trouble is in the transformer winding from point A to point B in Fig. 16.

NOTE: For the boost indicator to light up, R.F. pulses must be present on the plate of the horizontal output tube. This, in turn, means that boost B+ must be present, for without this additional voltage, any R.F. pulses produced will be too weak to light up the boost indicator. This makes the boost indicator doubly valuable because it provides a positive indication of whether the circuit is or is not operating.

3. If neither the boost indicator or the high voltage indicator light up, when the horizontal plate driving pulse is applied to the transformer, we proceed in the following manner:

   With a voltmeter, check the DC voltage at the plate of the horizontal output tube. We know that boost B+ is absent and this test is designed to reveal if any B+ is reaching the tube. If zero voltage is measured at this point, then either the voltage is being shorted out by boost filter capacitors C-3 and C-4 or the linearity coil L-1 is open. Short out the linearity coil and test the circuit again. If everything returns to normal, the linearity coil is open. If no change occurs we can presume that the coil is OK.

   Check capacitors C-3 and C-4 for any short or leakages. It should be noted here that a failure of the boost B+ voltage being applied to transformer terminal C will cause very little horizontal output signal because the output tube does not have enough plate voltage. This is because the boost B+ voltage is providing the power for the plate of the horizontal output stage.

   Returning to the damper circuit, if B+ voltage only is measured on the boost B+ line, it indicates that no high pulse voltage is being rectified and added to the B+ to develop a boost B+ voltage. There is another boost circuit defect which can cause this and that occurs when capacitor C-7 (Fig. 16) is shorted. For this condition, the B+ voltage will be applied from the plate of the damper tube to the cathode; there will be no rectification in the damper tube and hence no boost B+ voltage. This possibility can be checked by removing the damper tube from its socket and nothing whether the B+ voltage is still being measured at the cathode terminal of the damper tube socket. If the answer is yes, C-7 is shorted and should be replaced. However, if no voltage is present at the cathode of the damper tube with the tube out of its socket, then C-7 is not shorted and the damper tube can be returned to its socket.

   The role played by the two special indicator lamps provided with the TV Analyst demonstrates how useful they are in assisting the technician isolate a defect in the horizontal output circuit. Once their use becomes understood, they will be found to save many hours of service work.

4. We shall now demonstrate how to locate quickly a defect in the horizontal output system consisting of the transformer itself, the horizontal yoke or any of the associated components attached to these units. To check the horizontal yoke, it is only necessary to disconnect the yoke from the circuit so that any shorting effect a defective yoke might have on the rest of the circuit is removed. If now, with the plate drive signal applied to the horizontal output transformer, the boost indicator lights up as well as the hi voltage indicator showing that high voltage is being produced, then the defect in the set has been isolated to a shorted yoke. As a matter of fact, a vertical white line will appear on the screen of the TV receiver being tested, if the high voltage rectifier has been replaced in its socket. However, if the yoke is not the defective component, there will be no change in indications at this time.

Make careful note where the yoke wires connect in the circuit. Also keep the yoke disconnected while the remaining tests are being made.

Next, the width coil is tested. To do this, it is disconnected completely from the circuit. Note the effect upon the boost indicator and hi voltage lights. If the width coil is defective, its removal from the circuit will bring back the high voltage. Under these conditions, both the B+ boost indicator and hi voltage indicator will light up. If the width coil is in series with the yoke in a particular circuit, remove the width coil at the same time the yoke is being removed. If the high voltage comes back again, one of these components is at fault. Reconnect the yoke first, using a connecting lead in place of the width coil. If the high voltage reappears, the width coil is the defective unit. This conclusion can be checked out by testing the yoke with the Shorted Turns and Leakage Test of the TV Analyst.

It is common practice to tap off pulses from various points on the secondary of the horizontal output transformer for use in the horizontal AFC and in keyed A.G.C. circuits. It may very well be that a defect exists in one of these auxiliary circuits which is having an adverse affect on the horizontal output transformer, loading it down and thereby preventing it from functioning normally. To determine if this is true here, disconnect one tap at a time, each time checking the indicators to see whether high voltage has returned. If the boost and high voltage indicators light up after one of these leads have been disconnected, then we know that the trouble exists in that particular auxiliary circuit. After this, it simply becomes a matter of tracking down the defect in the auxiliary circuit.

It may happen that even after all of the auxiliary components have been removed from the horizontal output transformer neither the boost or hi voltage indicators will light. This certainly points to a defective transformer and the TV Analyst has available the necessary tests to prove that the transformer is defective. At this point it might well be worthwhile to review the nature of defects that can occur in a horizontal output transformer. Some of the more obvious defects that can occur are open windings, shorts from one winding to another, hi resistance leakage from one winding to another or from a winding to the core of the transformer. The instrument provides a test for these conditions. There is another fault that is less obvious. A flyback transformer in operation is subject to both very high voltage pulses and relatively high temperatures. This can cause breakdown between turns in a winding resulting in one or two or more shorted turns within the winding of the transformer. These shorted turns represent a load on the flyback and a serious reduction in the "Q" of the whole system. As little as one shorted turn in a winding can result in an inoperative flyback system. These leakages and shorted turns can also occur in the horizontal windings of the deflection yoke and all of these tests are equally applicable to both. To test these components they must be completely disconnected from the circuit. To test for leakage and continuity the Calibrate control must be turned to the Leakage-Continuity position, which is fully counter clockwise. Connect the test leads to the Leakage Continuity test signal jacks and check continuity of the various windings. Presence of continuity is shown by a glow of the test indicator bulb. When measuring leakage between windings and from winding to core a glow of the test indicator shows that leakage is present. The leakage test will indicate leakage resistance from 0 to 10 megohms. Remove the leads from the Leakage-Continuity test jacks.

To test a transformer for shorted turns connect the shielded cable to the Flyback-Yoke test signal jack. Adjust the Calibrate control

until the test indicator lamp just goes out. Connect the flyback transformer to this cable. The connection is made from horizontal output plate cap connector to hi voltage rectifier plate cap connector. If the test indicator glows this indicates that the transformer has shorted turns. This test will respond to as little as one shorted turn. If the component to be tested is the horizontal winding of the deflection yoke, connection is made across the deflection yoke winding. It is also important to test the yoke for leakage between the vertical and horizontal winding and from the horizontal winding to the metal frame of the yoke.

Another very common arrangement is the autotransformer shown in Fig. 17. Here there is one winding to which all taps are made. The horizontal output tube is connected at point A and the stepped-up voltage for the high voltage rectifier tube is obtained from point B. Horizontal deflection yoke coils are connected across points C, D and E. All of the testing methods just outlined for the isolation horizontal output transformer are applicable here, too. The boost indicator and hi voltage still function as before, for the same conditions, and both are connected as before. The ability of the instrument to check for continuity can be put to good use here because continuity should exist between all points on the transformer. If continuity is not obtained, the transformer is open.

In Fig. 17 L-1 serves primarily as a filter coil. If this component should open, no B+ would be available to the horizontal output tube, and if L-1 was shorted, the circuit would still operate normally; it is

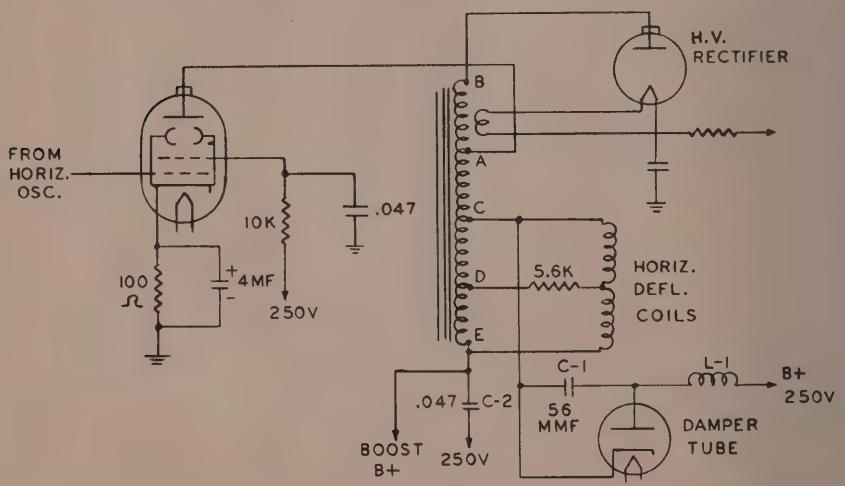


Figure 17—A Horizontal Output Section using an Auto Transformer type of output transformer

quite possible that considerable RF interference would appear in the picture. If no interference did appear, there would be no visual indication of a short in L-1. If C-1 should short, the damping tube would be effectively cut out of the circuit and no boost B+ would be developed. B+ voltages, however, would appear on the B+ boost line and at the plate of the horizontal output tube. If C-1 should open, it would have very little effect on overall operation, although here, again, RF interference might appear in the image.

Capacitor C-2 is the component receiving the additional voltage which the damper tube develops. If C-2 should short, no boost B+

could be developed by the circuit and it would prevent the development of the normal amount of high voltage or the normal amount of horizontal drive for the yoke. If C-2 should open, the circuit would again be disrupted by the lack of boost B+ voltage. B+ voltage, however, would still appear because the damper tube and L-1 would still be intact.

The foregoing examples indicate the complete flexibility of this instrument. With continuous use the technician will certainly develop his own procedure which will completely remove all of the complexities of Sweep Circuit Analyzing.

TROUBLE SHOOTING CHROMA CIRCUITS

Loss of color, weak color or distorted color can occur in the R.F. or I.F. sections of a receiver as well as in the Chroma Circuits. The Analyst is particularly useful in trouble shooting this type of complaint as either the R.F. or I.F. signal may be modulated with the Rainbow Color signal and this signal injected, into the R.F. or I.F. stage by stage to localize the defective stage.

The Chroma signal is also available at the output jack labeled Color and may be injected directly into the Video Detector, Video Amplifier, Band pass Amplifier or to the grid of low level demodulators.

These tests quickly pin down complaints of no color, weak color, and distorted color. They also localize phase errors by showing the wrong sequence of colors.

Phase errors arise in the Chroma section, or in the I.F. section. It is possible for the R.F. section or Video section to cause phase errors, but these are less common trouble points. If you inject the Chroma signal into the Band pass Amplifier and get a normal color pattern the next step is to inject an I.F. signal modulated with chroma information at the input of the I.F. Amplifier.

When a phase error is found in the latter test, it is indicated that the I.F. Amplifier is in need of proper alignment. On the other hand, a phase error in the former test indicates the need of Chroma circuit alignment.

A color bar pattern slide is enclosed in the accessory package of your Television Analyst to enable you to convert the rainbow pattern which it produces into a color bar pattern of known colors. At this point it might be well to review the principle of operation of a rainbow pattern and then relate it to a color bar pattern.

The different hues that can be produced in a color TV receiver are obtained by shifting the phase of the color sub-carrier of the transmitted signal with respect to the reference burst which occurs during the horizontal blanking interval. For example, if the phase of the sub-carrier is shifted slowly through a complete 360° with reference to the burst signal, the hue will change from yellow to orange, to red then magenta, blue cyan and green, and all of the intermediate hues between those colors. If the phase of the sub-carrier signal is continuously changed thru a full 360° during the interval of one horizontal line and repeats itself for each following horizontal line, a continuous rainbow of colors will be produced. Instead of shifting the phase of the sub-carrier in the TV Analyst, we will make the frequency of the sub-carrier lower than the color oscillator in the TV receiver by 15,750 cycles. There will then be a one cycle per line difference between the sub-carrier and the oscillator in the receiver. Since over a period of one horizontal line there is one cycle difference between the two signals, we have effectively created a 360° phase shift per horizontal line which will repeat itself each horizontal line. This will result in a rainbow display showing each of the colors in the color spectrum

from yellow to orange, red, blue and ending in green. This method of producing the color signals is called off-set sub-carrier operation.

By referring to Fig. 18 you will see the vector display of the color information that can be obtained for a phase shift of any given number of degrees. For example, 60° represents a +(I) signal. A 90° phase shift represents +(R-Y). 180° represents +(B-Y) and a +300° represents (G-Y). In order to change a color rainbow signal to a color bar signal, we merely have to blank out those portions of the rainbow display that we do not want and

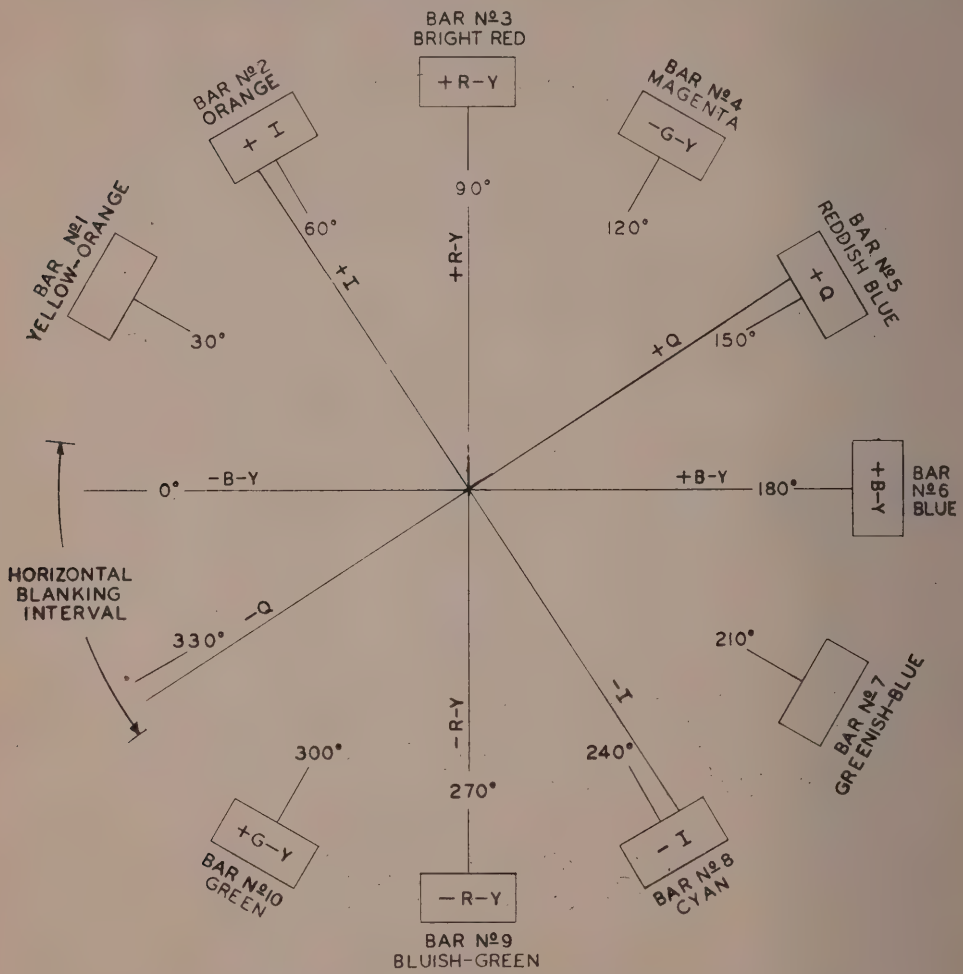


Figure 18—Vector display showing color bars and angular displacement for each bar

allow the portion of the rainbow that we do want to come through. This we accomplish with the color bar slide enclosed in your accessory package. You will note that there are ten light intervals and nine dark intervals equally spaced on the slide. Each bright interval, or bar, represents a color phase shift of 30° and is so placed on the slide as to give the colors as indicated in Fig. 19. You will note for example in Fig. 19 that the second bar is indicated as orange and its color corresponds to +(I) since it is 60° from the reference signal. The sixth bar for example, is a blue color and corresponds to +(B-Y)

since it is 180° from reference signal. Fig. 19 will be extremely useful in servicing color TV receivers since it will enable you to evaluate performance of the receiver. It will also enable you to check the range of the hue control and will provide a simple method of color demodulator alignment.

Since most of the color TV receivers in use today demodulate an +(R-Y) and a +(B-Y) signal, our discussion of demodulator alignment will refer to this condition only.

Connect the Television Analyst to the receiver under test and set up and adjust for a proper picture on the TV receiver. Be sure that the horizontal frequency of the Analyst is adjusted to the correct frequency. This is explained in your instruction manual. Turn the color signal on and insert the color bar slide into the Analyst. Adjust video control on the Analyst to get

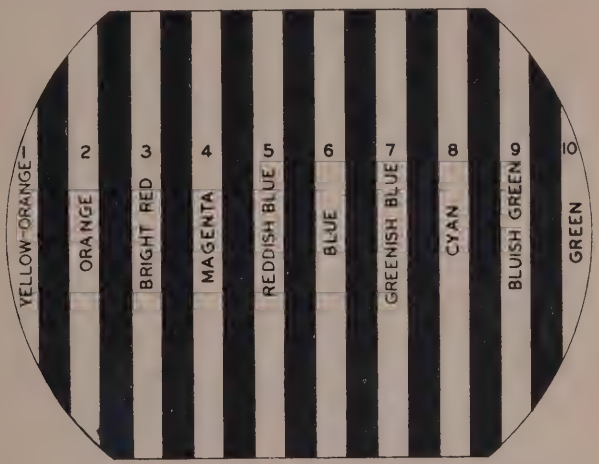


Figure 19—Color bar pattern showing each bar, its number and its color

good reproduction of the bars and adjust chroma and hue controls for the proper level of the color signal and that the color bars occur in the proper sequence as shown in Fig. 19. If the color bars do not fall into the proper sequence, the coarse adjustment of the hue range found inside the receiver will center the range of the hue control. At this point it is well to indicate that the horizontal width of the receiver under test should be reduced to be certain that all ten bars are seen.

From fundamental color theory we know that the output of the +(R-Y) demodulator if properly adjusted should have zero +(B-Y) output, and the output of the +(B-Y) demodulator should have zero output of +(R-Y) signal.

Since our color bar pattern has both an +(R-Y) signal which is the third bar, and a +(B-Y) signal which is the sixth bar, we can use these signals to check and align color demodulators.

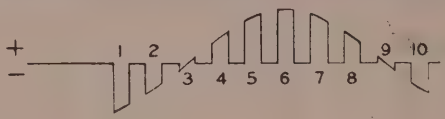
Connect an oscilloscope of adequate band width to the output of the +(R-Y) demodulator. You will see a waveform similar to that shown in Fig. 20. This is viewed at a 15,750 cycle per second sweep on the oscilloscope. The sixth bar which is +(B-Y) should be at zero amplitude as shown in Fig. 20. If this condition is not met, set the hue control to its center position and adjust the coarse hue control adjusment which is located within the TV receiver so that the sixth bar is at zero amplitude. Now move the oscilloscope to the output of the +(B-Y) demodulator and adjust the quadrature transformer driving the +(B-Y) demodulator so that the third bar which is +(R-Y) is at zero amplitude as shown in Fig. 21.

The color demodulators are now properly aligned so that no +(R-Y) signal gets through the +(B-Y) demodulator, and also no (B-Y), signal gets

R–Y DEMOD.
OUTPUT

Figure 20—(R-Y) demodulator output as seen on an oscilloscope

through the +(R-Y) demodulator. Also the front panel hue control is in the middle of its range to allow variations in both directions if necessary.



B–Y DEMOD.
OUTPUT

Figure 21—(B-Y) demodulator output as seen on an oscilloscope

This completes the hue control and demodulator adjustments.

HOW TO ADJUST COLOR PURITY AND CONVERGENCE

Adjusting Color TV Purity and Static Convergence

The first adjustment normally made on a color set is purity. It is best to follow the set manufacturers' procedure for purity adjustment. It is, however, most desirable to make this purity adjustment on a blank synchronized raster. This can be accomplished by connecting the generator to the color receiver antenna terminal and tuning in a test pattern, as previously explained. Then remove slide from pattern generator and make purity adjustment on synchronized blank raster.

For static convergence adjustments, it is necessary to use a white dot generator. Your Television Analyst will provide white dots merely by using the white-dot slide. As a matter of fact, it is preferable to use the TV Analyst because the critical number of dots required for static convergence adjustments is fixed, and therefore is not subject to misadjustment as are the dots on most commercial dot generators. Also, the center dot is surrounded by little squares so that it is easy to identify at a glance the location of the center dot. This is a great time-saver since it is essential that the center dot location be known. The small squares around the center of the slide make it easier to get fine static convergence adjustments, as the sharp corners of the squares show up any misconvergence much more critically than round dots. Make static convergence adjustment at the center of the screen. The red, blue and green dots have a motion as shown in Figure 22 and should be adjusted so that each dot is superimposed upon the other (to obtain a white dot).

Dynamic Convergence Adjustments

After purity and static convergence adjustments are made, you are then ready to make dynamic convergence adjustments. Insert the white-line slide in the generator. Be sure to set horizontal to correct frequency as explained

previously. It is of utmost importance in color convergence that the horizontal frequency is adjusted accurately.

If horizontal frequency tends to drift a few cycles, as noted by a slight vertical movement of the horizontal lines, it can be stabilized by a slight adjustment of the HORIZONTAL control.

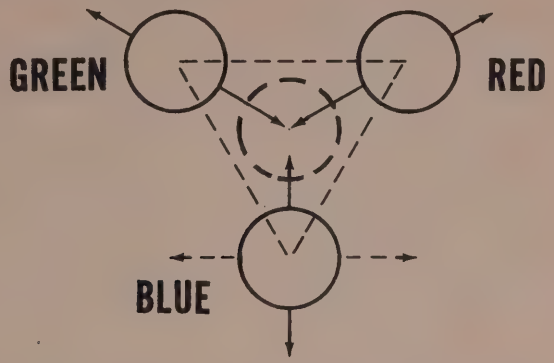


Figure 22—Direction of dot movement for static convergence

STEP A—*Preliminary Adjustment*

1. Turn the blue horizontal (parabola or sine-wave) amplitude control to maximum.
2. Adjust the blue horizontal (parabola or sine-wave) phase so that the dip in the horizontal blue bar appears in the center of the horizontal axis of the raster.
3. Re-adjust the blue horizontal (parabola or sine-wave) amplitude to produce a reasonable straight horizontal bar along the horizontal axis of the raster.

STEP B—*Setup of the Vertical Convergence Controls (See Figure 23).*

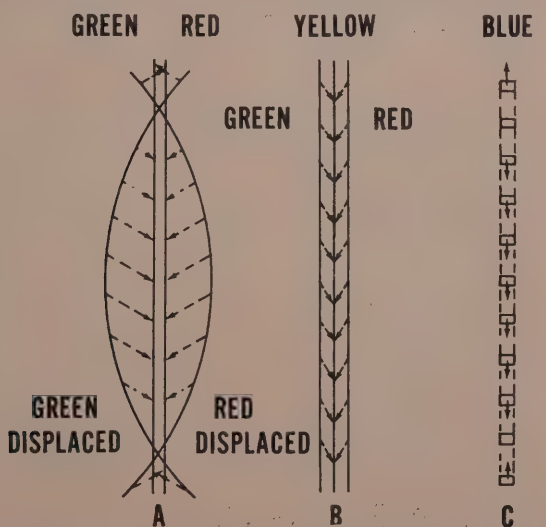


Figure 23—Dot motion due to adjustment of vertical phase and amplitude controls

1. Adjust the red vertical parabola amplitude and phase control to make the red vertical bar, along the vertical axis of the raster, parallel or coincident with the associated blue bar.
2. Adjust the blue vertical parabola amplitude and phase controls to make the horizontal blue bars, along the vertical axis of the raster, equally spaced or coincident with their associated horizontal red bars. (Since the horizontal convergence has not been completely set up, the associated red and blue horizontal bars will not necessarily appear parallel to each other).
3. Adjust the green vertical parabola amplitude and phase controls to make the vertical green bar parallel or coincident with the associated red bar along the vertical axis of the raster. (IF STEP B, (1) was set up properly, the red and green vertical bars will be parallel and the red and green horizontal bars along the vertical axis of the raster will be equally spaced. If these conditions do not exist, STEP B, (1) and (3) should be repeated).
4. Insert white dot slides in pattern generator and statically converge the three dots in the center of the raster.

STEP C—*Setup of the Horizontal Convergence Controls* (See Figure 24).

1. Insert white line slide in Television Analyst.

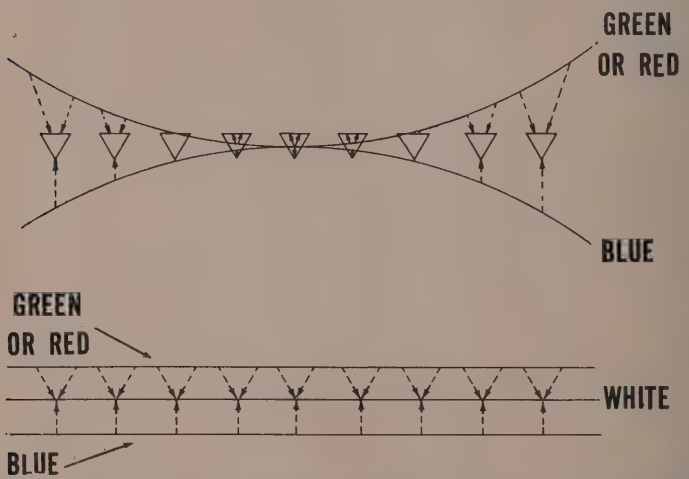


Figure 24—Dot motion due to adjustment of horizontal amplitude and phase controls

2. Adjust the red horizontal (parabola or sine-wave) amplitude and phase controls to make the vertical red bars across the horizontal axis of the raster equally spaced or coincident with the vertical blue bars.
3. Adjust the blue horizontal (parabola or sine-wave) amplitude and phase control to make the blue bar, along the horizontal axis of the raster, parallel or coincident with the associated red bar.
4. Adjust green horizontal (parabola or sine-wave) amplitude and phase controls to make the vertical green bars, along the horizontal axis of the raster, equally spaced or coincident with the associated red bars. (If STEP C, (2) was properly set up, the associated red and green vertical and horizontal bars will be parallel or coincident. If these conditions cannot be obtained, repeat STEP C, (2) and (4).

STEP D—Insert white dot slide and statically converge the dots in the center of the raster.

MODEL 1076 VOLTAGE WAVEFORMS

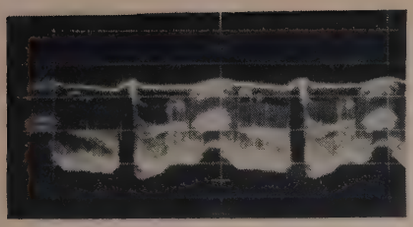


Fig. 1. VIDEO only from photomultiplier obtained at G-1 of V2A (12AT7) 1/2V P.P.

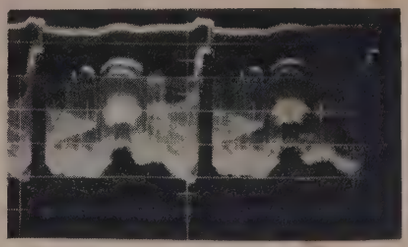


Fig. 2. COMPOSITE VIDEO at grid G-1 (V4A) of modulator, 1V P.P.

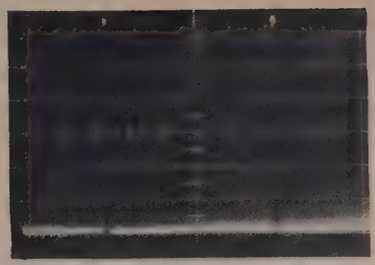


Fig. 3. COMPOSITE SYNC at grid of sync paraphase (V3A), 100V P.P.

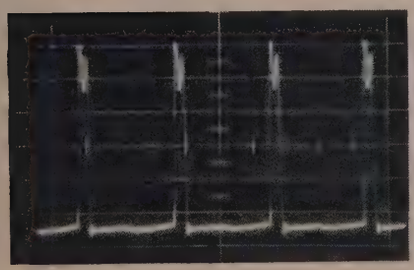


Fig. 4. HORIZONTAL SYNC to cathode of sync mixer Pin 8 (V-2B), 7V P.P.

Fig. 5. VERTICAL SYNC to G-1 (V-2B) of sync mixer, 40V P.P.

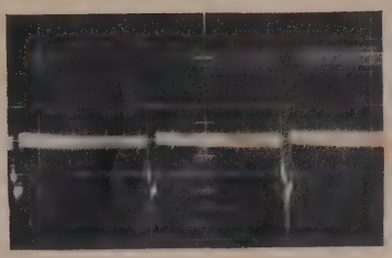


Fig. 6. HORIZONTAL BLKG at cathode of CRT, 38V P.P.

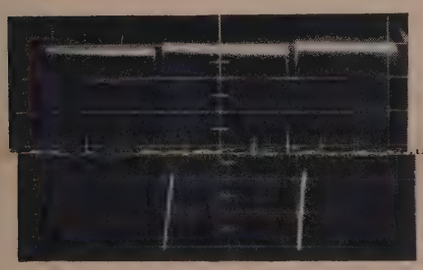


Fig. 7. VERTICAL BLKG at G-1 of CRT, 90V P.P.

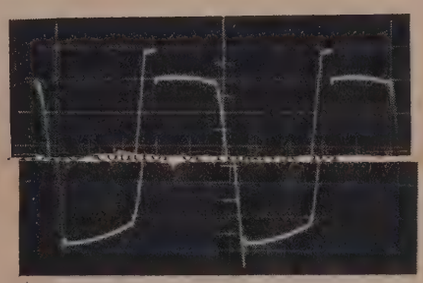


Fig. 8. VERTICAL DISCHARGE TRIGGER PULSE at G-1 of Vert discharge V-8A, 140V P.P.

Fig. 9. VERTICAL SAW at G-1 of (V-8B) Vertical output, 80V P.P.

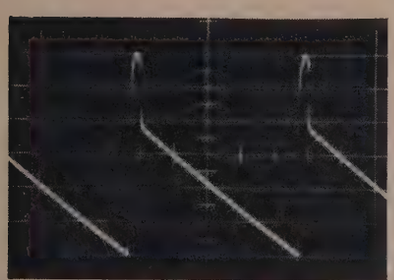


Fig. 10. PLT WAVEFORM of (V-8B) vertical output, 300V P.P.

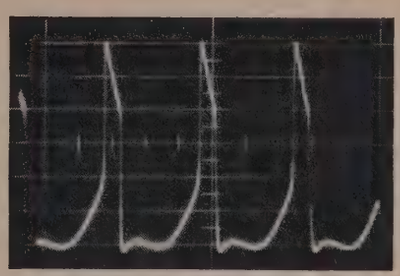


Fig. 11. HORIZONTAL DISCHARGE GRID PULSE G-1 of (V-9B) Pin 2, 60V P.P.

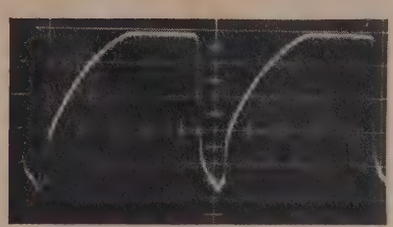


Fig. 12. HORIZONTAL SAW at G-1 of horizontal amp (V-10), 95V P.P.

Fig. 13. Shorted Turns Oscillator grid waveform at G-1 of V-14B, 220V P.P.

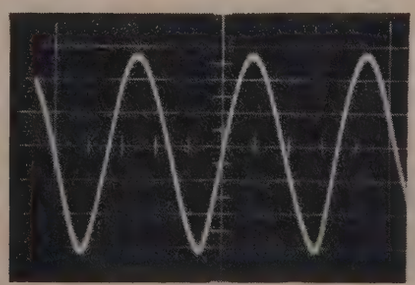


Fig. 14. Audio Tone Signal at Junction of R-402 and R-404 3V P.P.

VOLTAGE CHART
PIN NUMBERS

TUBE		1	2	3	4	5	6	7	8	9	10	11	12	CAP
V-1	931A	-75	-20	25	75	130	150	200	225	275	350	-150		
V-2	12AT7	150	0	0.75	0	0	125	0	0	6.3 A.C.				
V-3	12AU7	112	-115	-85	0	0	140	0.25	15	6.3 A.C.				
V-4	12AT7	75	0	0	0	0	175	0	0.25	6.3 A.C.				
V-5	6CB6	0	0.20	6.3 A.C.	0	195	0							
V-6	6AN8	50	-3	0.25	0	6.3 A.C.	220	160	0	3.5				
V-7	12AX7	20	0	1	6.3 A.C.	6.3 A.C.	150	0	1	0				
V-8	6DE7	200	0	0	6.3 A.C.	0	125	-70	0	25				
V-9	6CG7	210	-12	10	0	6.3 A.C.	260	0	10	0				
V-10	6DQ6	0	0	-35	80	-35	0	6.3 A.C.	0					* CAUTION DO NOT MEASURE
V-11	6DQ6	0	6.3 A.C.	0	125	0	0	0	18					
V-12	6AX4	0	0	*	0	210	0	0	6.3 A.C.					
V-13	1X2				12,500 ALL PINS									*
V-14	12AU7	225 A.C.	-25	0	6.3 A.C.	6.3 A.C.	220	0	0	0				
V-15	6CA4	240 A.C.	0	245	6.3 A.C.	0	0	240 A.C.	0	0				
V-16	5BKPV-1	0	0	0	0	0	-150	0	0	0	350	40	6.3 A.C.	

ALL READINGS TAKEN WITH 20,000 OHMS VOLT D.C. & 5,000 OHMS VOLT A.C. METER MEASURED TO CHASSIS GROUND.
OFF-AUDIO-TONE SWITCH IN TONE POSITION FOR PINS 6, 7 & 8 OF V-7.
OFF-AUDIO-TONE SWITCH IN AUDIO POSITION FOR PINS 1, 2 & 3 OF V-7.
PLATE DRIVE SWITCH VERT. POSITION.
LEAKAGE CALIBRATE CONTROL COUNTER-CLOCKWISE.
R.F. OUTPUT MAXIMUM. SELECTOR SWITCH AT I.F.
VIDEO GAIN ADJUSTED FOR 2 V PP AT VIDEO OUTPUT TERMINALS.
COLOR ON-OFF SWITCH TO ON.

PM219 9-60 RR PRESS

OTHER USES FOR THE TELEVISION ANALYST

1. *Displaying Your Own Pictures and Patterns on Any TV Receiver*

The Television Analyst will transmit any positive and transparent picture or pattern. The only requirement is that the size of the pattern be limited to 3-by-4-inches. Hence, any pattern drawn with a black crayon on a piece of clear plastic or acetate the same size as the slides furnished with the instrument can be used in the slide-holder. One blank acetate slide is provided with the instrument. Be sure crayon side of slide is facing away from CRT tube. To display black-and-white photos on a TV receiver, merely have a positive film transparency made and use it in the slide-holder. For best results, the film transparency should be enlarged or reduced so that the picture area is about 3-by-4 inches. The full size of the film transparency should be 4⅞" x 6½" in order to fit properly.

2. *Adjusting Linearity and Size*

Connect Television Analyst to antenna terminal of receiver under test. Adjust generator to obtain test pattern of good contrast. Adjust vertical size and linearity of the TV receiver so that outer circle of the test pattern just fills the vertical height of the picture tube. Adjust horizontal size and linearity for as round a circle as possible. It may be necessary to re-adjust receiver vertical height and linearity after horizontal adjustments. The center of the test pattern should coincide with the center of the receiver picture tube. Adjustments of receiver centering controls will accomplish this.

3. *Checking Receiver Resolution*

Connect Television Analyst to the receiver under test. Set channel selector of TV Analyst to an unused channel. Set fine tuning of receiver to obtain a picture display of the best resolution. Adjust VIDEO control of Analyst for good contrast and shading. By observing the resolution wedges on the test pattern (See Fig. 25) one can determine the resolution of the receiver under test. The number of lines of resolution can be read from the test pattern by observing the point at which the lines in the wedges blend together. An average receiver should show approximately 250 lines of horizontal resolution, which is read from the vertical wedge in the test pattern. Any receiver that shows substantially less than 250 lines might be an indication that the receiver requires realignment. The Television Analyst signal when displayed at video through a good video monitor will reproduce a pattern of approximately 400 lines of resolution.

4. *Using the Television Analyst for Display Purposes*

To use the Analyst to display pictures on a number of TV sets, connect its output to the input of the master antenna amplifier through a suitable matching network. Adjust the CHANNEL SELECTOR control for a good picture on the display sets, on an unused channel. Set the R.F. ATTENUATOR so that overloading of the master antenna amplifier does not occur. Set the HORIZONTAL control for a stable picture. Set the VIDEO Control for best picture contrast. After these initial adjustments, only the VIDEO control will have to be adjusted for the different slides which may be used.

If the harmonics or fundamentals of the VHF oscillator interfere with a local station in the area, it may be necessary to use a high pass or low pass absorption filter to eliminate the interference. For example, if the Analyst is set to a channel below Channel 7 and interference occurs at Channel 7 or above, connect the output of the TV Analyst to the input of the filter and take the signal out of the low-band (channels 2 through 6) terminals of the filter.

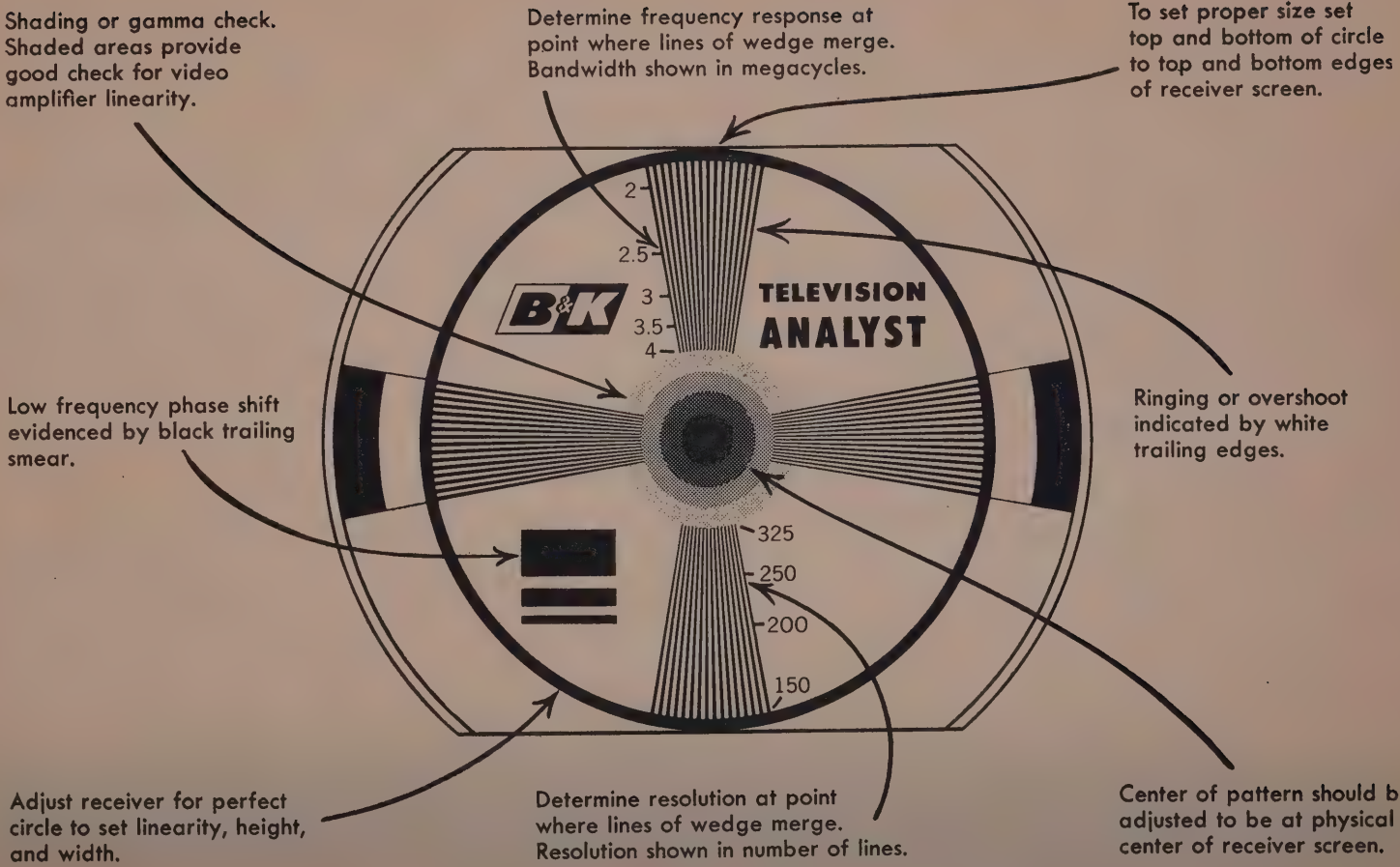

Shading or gamma check. Shaded areas provide good check for video amplifier linearity.
Determine frequency response at point where lines of wedge merge. Bandwidth shown in megacycles.
To set proper size set top and bottom of circle to top and bottom edges of receiver screen.
2
2.5
3
3.5
4
B&K
TELEVISION
ANALYST
Low frequency phase shift evidenced by black trailing smear.
Ringing or overshoot indicated by white trailing edges.
325
250
200
150
Adjust receiver for perfect circle to set linearity, height, and width.
Determine resolution at point where lines of wedge merge. Resolution shown in number of lines.
Center of pattern should be adjusted to be at physical center of receiver screen.

Figure 25—Test Pattern

All harmonics above Channel 6 will be absorbed by the filter, thus eliminating the high-band interference. Likewise, if the generator is set for a channel above Channel 6 and interference occurs at Channel 6 or below, use the filter and take the output from the high-band (Channels 7 through 13) terminals.

5. *Using the Television Analyst as a Video System Transmitter*

Operate the Television Analyst as directed under "Displaying Your Own Pictures." Write or type the names of the persons being paged on a transparent piece of acetate. To type on the acetate, shift the lever on your typewriter to position where ribbon is not used. Take 2 pieces of good quality carbon paper and insert acetate between them so carbon surfaces are against the front and back of acetate. Put in typewriter and type message in area 3-by4-inches. The clear slide provided has this area marked off. The acetate may be used again by just wiping the carbon printing off.

THEORY OF OPERATION

The Television Analyst is a complete flying spot scanner Video Signal Generator coupled with a radio frequency transmitter. For the reader's con-

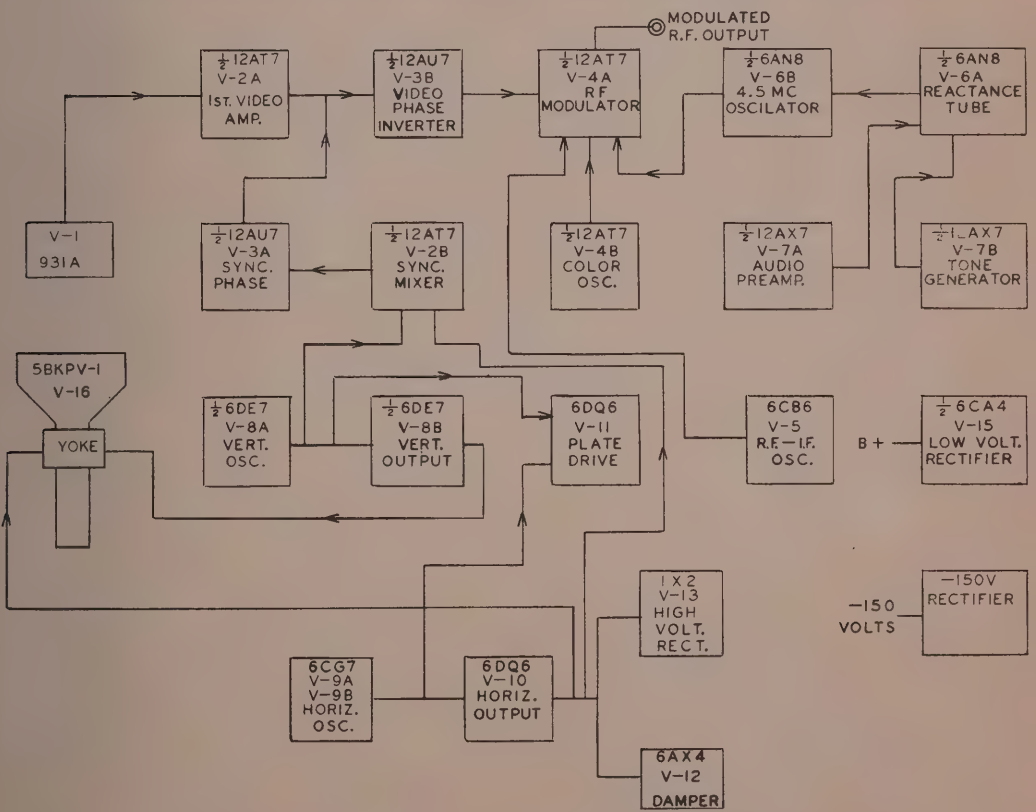


Figure 26—Block diagram of TV Analyst

venience, a block diagram of the complete instruments is shown in Fig. 26. Many of the circuits in this instrument are quite familiar to the service technician, because they are used in most television receivers. Some of these circuits are new and greater emphasis will be placed upon the description of these circuits.

The Scanning System

The first of these circuits pertains to the conversion of light energy to electrical energy. Certain materials have the ability to emit electrons when they are exposed to light, much the same as the cathode of a conventional electron tube does when it is heated. These materials are known as photoemissive materials. When a photoemissive material is used as the cathode of a diode, any light striking the tube will cause the cathode to emit electrons. These electrons, flowing through the diode load resistor, cause a voltage to be developed across the resistor. Such a tube is shown in front of a transparent slide in Figure 27.

As the small spot of light from the cathode-ray tube sweeps across the slide from left to right, light energy passes through the transparent portions of the slide. When the spot passes behind parts of the opaque "A" painted on the slide, the pattern blocks the light energy. Therefore, during some parts of the spot's sweep across the slide, light energy strikes the photoemissive cathode of the photo tube, while at other times it does not. This energy develops a varying voltage across the load resistor. Thus, part of the "A" on the slide has been changed to an electrical signal, as shown in Figure 27. As illustrated, when light energy is transmitted through the transparent portion of the slide, a voltage is developed across the resistor, and when the "A" blocks the light, no voltage is measured.

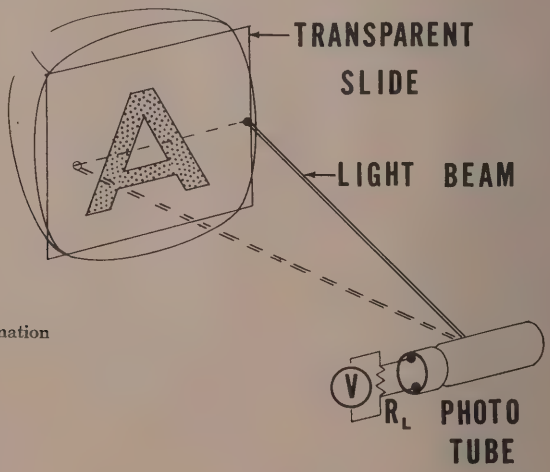


Figure 27—Changing Video Information to an Electric Signal

The cathode-ray, or "scanner" tube used in the Generator is specially designed to match the spectral response of the photomultiplier pickup tube.

As shown in Figure 27, the spot of light produced by the scanner starts at the top of the faceplate, sweeps across to one side, is blanked while it returns to the other side (retraces), sweeps to one side, is blanked while it returns to the other side (retraces), etc., until it finally reaches the bottom of the screen. It is then blanked and returned to the top of the screen. If the "A" of Figures 27 and 28 is placed over the face of the scanner tube, the dot of light and photomultiplier tube translates the entire pattern, spot by spot, into a video signal.

The electrical impulses which have been produced as a result of the light variation on the photomultiplier tube are developed across the photomultiplier load resistor R-102 on your schematic. This is a 1000 ohm resistor.

The video signal is capacity coupled to the grid of V-2A. V-2A is the first video amplifier. In order to improve the high frequency response of the system, inductive peaking is employed in the plate circuit of this tube and R.C. peak-

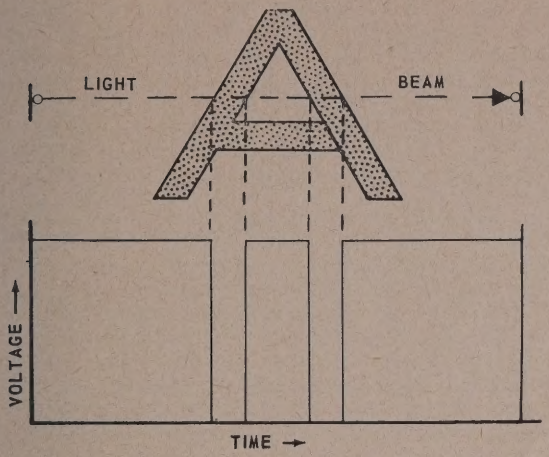


Figure 28—Voltage as Light Beam Moves Across Pattern

ing is employed in the cathode circuit. In the plate circuit of V-2A there is a 500 ohm potentiometer which is part of the plate load resistor of V-3A. It is the common coupling between these two stages which mixes the synchronizing information with the video information to produce a composite signal of both sync and video. This signal is present at the plates of V-2A. This composite signal is capacity coupled to the grid of V-3B. Outputs are taken from both plate and cathode of V-3B and appear on the front panel as the video output, either sync positive or sync negative, depending upon whether the polarity reversal switch selects the plate or the cathode circuit. The plate load resistor for V-3B consists of two 470 ohm resistors. The signal present at the junction of the two resistors is capacity coupled to V-4A which is the R. F. modulator. The R.F. modulator receives in the cathode circuit the output of the raido frequency oscillator V-5. Also present at the cathode is the output from the 4.5 mc sound system and the output of the color oscillator. Modulation results in this tube, and the modulated R.F. output is taken from the plate and is capacity coupled to R-29A part of the R.F. Attenuator network. It is at this point that the modulated R.F. signal is available on the front panel.

Synchronizing information is obtained by mixing a combination of vertical and horizontal signals in V-2B. A few turns of wire which form the secondary of the width coil L-2 provides the cathode return of V-2B. A vertical pulse from the vertical saw generator is applied to the grid of V-2B through suitable filtering to remove horizontal pulses. The mixing is accomplished in the plate circuit of this tube, and at pin 6, the plate, both vertical and horizontal sync information is present. This is capacity coupled to the grid of V-3A where additional amplification and clipping of the sync signal is accomplished. Part of the load resistor of V-3A is common to V-2A. This is the previously mentioned 500 ohm control which is the Sync Level Adjust. A potentiometer is connected from the plate and cathode of V-3A. When the potentiometer is in its center position it is affectively at signal ground an no output will appear at the sync output jack. As the potentiometer R-2 is rotated either clockwise or counter clockwise you will approach either the plate or the cathode signal. This enables the user to acquire either sync positive or sync negative at the

output jack by merely rotating the sync amplitude and phase control. V-4B is the crystal controlled color subcarrier oscillator. This oscillator is factory adjusted to a very precise frequency to assure the proper rainbow display or color bar display when used in trouble shooting color television receivers.

The R.F. oscillator circuit V-5 is basically a Colpitis Type oscillator with the tuning inductances switched in by means of a selector switch. Each channel has its own coil and is pre-tuned to the correct frequency. This switch also enables the operator to switch-into the I.F. position the proper coil which resonates with C-17 the I.F. tuning capacitor, thus the instrument is capable of tuning television channels 2, 3, 4, 5, 6, 7, 8, 12 and 13, plus the I.F. range of 20 to 48 mc. In order to obtain smooth R.F. Attenuator action the screen voltage of the oscillator tube is varied at the same time that the R.F. output signal from the modulator is varied. This is accomplished in R-29A and R-29B, a dual potentiometer. The output from the R.F. oscillator is capacity coupled from the plate of V-5 to the cathode of the modulator stage V-4A.

The sound system consists of one half of a 6AN8 4.5 mc oscillator whose output is taken from the cathode of V-6B. The second section of the 6AN8 V-6A is the F.M. reactance tube to provide frequency modulation on the 4.5 mc oscillator. This reactance tube can be driven from two sources, one source is V-1B, one half of a 12AX7. This tube is connected as a phase shift oscillator and produces the 400 cycle internal tone. This tone is also available from a front panel jack. The second section of the 12AX7 is connected as an audio amplifier whose imput can be any source desired such as an external signal generator, F.M. tuner, tape recorder, microphone, etc. The minimum signal requirements for full modulation at this audio input is approximately 30 millivolts.

We will now turn our attention to the vertical deflection system. This deflection system consists of a neon lamp NE-2L and 6RE7 twin triode. The Television Analyst is synchronized directly to the 60 cycle power line and this is accomplished in the following manner. A high level signal taken from one side of the high voltage winding of the power transformer is fed into NE-2L. This lamp will not conduct until approximately 65 volts appears across it. Therefore, the sine wave introduced from the A.C. line from the power transformer is effectively clipped into a square wave whose peak to peak amplitude is approximately 130 volts. This signal is then used to key one half of the 6BE7, V-8A, into conduction. This allows capacitor C-204 to discharge through the tube and then during the scanning interval V-8A is cut off due to grid leak bias, and C-204 will again charge. When the keying pulse comes along to drive V-8A into conduction C-204 discharges during the retrace interval. The saw tooth signal thus acquired as capacity coupled into R-207 the vertical size control to the grid of the vertical output stage. The vertical output stages consists of the second half of V-8B. Vertical linearity it accomplished by adjusting the cathode resistance by means of R-206 the vertical linearity control. The transformer in the plates of V-8B matches the impedance between the vertical output tube and the deflection yoke. No vertical hold control is required since the vertical oscillator system is keyed directly from the A.C. line.

The horizontal deflection system consists of V-9 a 6CG7 connected as a cathode coupled multi-vibrator employing sine wave stabilization. The stabilizing network consists of L-201 the ringing coil tuned with a .005 mfd capacitor, making this network resonant to 15,750 cycles. Since L-201 is a relatively high "Q" device it exercises major control in establishing and maintaining the frequency of the oscillator. It is this coil which accounts for the excellent long term stability of the horizontal circuit. Two horizontal frequency adjustments are provided. One of them being R-11 the fine horizontal frequency which is a front panel control, and R-211 the coarse horizontal frequency control which is an auxillary adjustment located within the instrument. The saw tooth waveform developed as a result of the charge and discharge of C-216 is

capacity coupled to the grid of the horizontal output stage. A horizontal drive control is provided and is of the series type. Maximum capacity, representing maximum drive to the horizontal output system. The horizontal output transformer and high voltage circuits are conventional and are the auto transformer type using a 6AX4, V-12, as the damper tube, and a 1X2, V-13, as the high voltage rectifier. The recovered high voltage from this system is approximately 12.5 kv at a 75 microampere load. A width coil is employed to control the horizontal scan that is shunted across a portion of the horizontal output transformer winding. A tap from this same transformer is capacity coupled to the front panel and is used as the high level A.G.C. keying pulse. V-11, a 6BQ6, is used for both vertical and horizontal plate drive. Examination of the plate drive selector switch will show that one section of the switch is used to choose between a vertical saw driving signal and a horizontal saw driving signal, both of them obtained from their respective oscillators. The second section of the switch is used to establish the proper bias for the 6DQ6 for both the vertical and horizontal position. The neutral position is off which opens the cathode of this tube, disconnecting it completely.

The next section under consideration is the horizontal output transformer and yoke shorted turns tester. This is a relatively simple circuit based on a pulse oscillator that is sensitive to inductance and "Q". The bias that is developed from this oscillator is fed to V-14A, a DC amplifier, which operates the test indicator neon lamp. Since shorted turns in yokes and flybacks most readily manifest themselves as a reduction in "Q" and since the oscillator circuit is sensitive to change in "Q" a bias voltage change is encountered which causes the DC amplifier V-14 to draw current and turn on the test indicator lamp. The change in "Q" reflected by a horizontal output transformer with as little as one single shorted turns is sufficient to disrupt the oscillator V-14B and cause the test indicator to light.

The power supply is very conventional. V-15, a 6CA4, is a low voltage rectifier. You will note that the cathode is fused with a ¼" fuse which protects the complete power supply from overload due to a short anywhere in the chassis. The filter consists of C-12A and C-12B and R-34 a 220 ohm resistor. This supplies the 200 volts DC required for operation of the chassis. A +175 volt point is acquired for operation of the video system by dropping and de-coupling through R-17 and C-12C. A tap on the power transformer provides a 117 volts AC signal to the selenium rectifier SR-1. The negative 150 volts thus developed is applied to the cathode of the photomultiplier tube. A tap on the voltage divider from this point to ground which is the sync level calibrate control, R-15, adjusts the total voltage appearing across V-3A the sync output stage. A second potentiometer in the voltage divider, R-16,, a 10K potentiometer, provides the calibrated negative bias appearing on the front panel of the instrument. The power supply also incorporates an Off-Stand-by-On switch. When in "Stand-by" position, heater power only is supplied to all tubes. When switched to the "On" postion, B+ is applied so that the instrument is ready for operation merely at the flip of a switch. It might be well to mention at this point that B+ boost which is derived from the horizontal deflection system is used to power the photomultiplier tube plate, and B+ boost is also used to drive the vertical saw generator stage. B+ boost is also used as a source of first anode voltage on the 5BKPV1 scanning tube. This higher voltage results in improved focus and spot size of the scanning tube which in turn will result in improved resolution. The vertical blanking signal for the 5BKPV1 scanning tube is derived from the vertical saw maker and is applied to the control grid of the scanning tube. The horizontal blanking information is derived from the cathode of V-3A the sync output stage that is capacitor coupled to the cathode of the scanning tube. This completes the circuit description of the Television Analyst.

SERVICE ADJUSTMENTS

The following section will deal with the method of adjusting the various auxiliary controls contained in the Television Analyst. Locations of these controls can be found by raising the cover. A tube and control layout diagram is located on the inside of this cover.

THE SYNC LEVEL control R-121, is adjusted in the following manner. An oscilloscope is connected from pin 2 to ground of V-4A the R.F. modulator. R-121 is adjusted for .35 volts peak to peak of sync signal. This is done with the video gain control turned to minimum.

COLOR OSCILLATOR adjust. Capacitor C-114 is preset at the factory and will probably not require adjustment throughout the life of the instrument. This applies even when V-4 is replaced. If re-adjustment of this control is necessary, it must be adjusted to set the frequency of the crystal oscillator to 3.563795 mc to an accuracy of .001 percent.

SYNC LEVEL CALIBRATE. This control determines the calibration of the sync amplitude output control and is adjusted in the following manner. With an oscilloscope connected to the sync output jack and the sync amplitude control set to either —50 or +50 resistor R-215 is adjusted for 50 volts peak to peak of sync information on the oscilloscope.

HORIZONTAL OSCILLATOR adjustments. There are three adjustments required to properly set the horizontal oscillator. They are the horizontal frequency fine, the horizontal frequency coarse and L-201 the ringing coil. To adjust proceed as follows. Short out L-201 with a jumper lead. Set horizontal frequency fine which is the front panel control to #5 on the calibrated dial. Adjust R-211 the coarse horizontal frequency adjustment so that the oscillator is running at exactly 15,750 cycles. A convenient method to do this is to superimpose on a television receiver a picture from a TV station and the picture from the Television Analyst. This can be most easily accomplished by having the TV receiver tuned to one channel and the Television Analyst tuned to the adjacent channel. By adjustment of the R.F. Attenuator the picture from the Television Analyst can be seen to float by. When the horizontal frequency coarse control is properly adjusted the picture will be standing straight up and thus floating by either to the right or to the left. When this has been accomplished, remove the short across L-201 and adjust it so that again the picture stands straight up and just floats by. This completes the Horizontal Oscillator adjustments.

LINEARITY SIZE AND CENTERING. The adjustment for these controls are described on page . . under "How to Set Up the Television Analyst."

THE VERTICAL SIZE, VERTICAL LINEARITY, HORIZONTAL SIZE AND HORIZONTAL DRIVE controls are adjusted to provide the best possible vertical and horizontal linearity. The Horizontal Drive control is best adjusted by starting with the trimmer turned four full turns open from its normally closed position. Advance the Horizontal Drive screw down until a drive bar appears and then back off until it just disappears. This will provide the best conditions for Horizontal Linearity.

LEAKAGE CONTINUITY TEST. Calibration is accomplished by placing a 10 megohm resistor between the two leakage continuity jacks and rotating the calibrate control on the front panel to the Leakage Continuity position. R-218 the leakage continuity calibrate control inside the chassis is then adjusted so that the neon lamp just lights.

4.5 mc OSCILLATOR adjustment. The frequency of the 4.5 mc oscillator must be adjusted with the Off-Audio-Tone switch in the "Audio" position. If an accurate 4.5 mc standard oscillator is available, then the two are brought